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ABSTRACT

As a manual for computer-assisted instruction lesson reviewers and as a resource for other interested PLATO personnel, this text describes the function of the lesson reviewer. The role of the lesson reviewer is discussed as an impartial examiner of the computer programing, the subject content, and the instructional design that constitute a computer based lesson. The reviewing procedure is described with emphasis on rationale, format, uses, and the role of the reviewer as a counselor. A sample review is included. (EMH)

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PLATO USER'S MEMO Number 3

LESSON REVIEW

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U.S. DEPARTMENT OF HEALTH
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For the sake of succinctness, masculine pronouns are used throughout this paper, but are intended to refer to both females and males. Having considered and discarded various clumsy alternatetives, however, we settled on this "disclaimer" . . . if only to point up the problem.

Table of Contents

	Page
Preface	iv
Chapter I - Lesson Review	1
1 - Why Have Lessons Reviewed?	3
2 - What Kinds of Reviews Can Be Performed?	4
Chapter II - Performing a Lesson Review	9
3 - How is the Reviewing Task Structured?	11
4 - What are Useful Reviewing Procedures?	15
Chapter III - Reviews of Computer-based Instruction Lessons	23
5 - What Form Should the Review Take -- Written or Oral?	25
6 - What Should The Author Provide for the Reviewer?	27
7 - If Reviews Are So Good, Why Doesn't Everyone Do Them?	30
8 - Why Must an Outside Agency or Person Look at the Lesson?	34
9 - What Can You Do with a Review?	36
10 - What is the Relationship of Reviewing to Student Testing?	39
11 - Who Should Review Lessons?	43
12 - How Does One Select a Reviewer?	48
13 - What Role, Responsibility, and Authority Should a Reviewer Have?	51
14 - What Can Go Wrong With A Review?	53
15 - Can a Checklist be Used to Review Lessons?	55
Chapter IV - End-of-Lesson Reviews	57
16 - Additional Techniques	59

17 - Sample Reviews. 62

Chapter V - In-Progress Reviews 85

18 - The Sociology of Reviewing. 87

19 - Sample Reviews. 95

Chapter VI - A Practice Review. 111

20 - "Binary Numbers" 115

21 - Discussion. 153

PREFACE

The Military Training Centers (MTC) group supports the efforts of authors using about 100 terminals funded by the Advanced Research Projects Agency (ARPA). These authors are geographically distributed around the United States at fifteen remote sites. The MTC group provides a number of services to these sites; lesson review is among the services offered.

The authors of this book assume the reader is familiar with the PLATO system and the TUTOR language. To make this book as useful as possible, we have used specific cases wherever applicable. It was written to service the needs of project administrators, authors, and reviewers. We hope this book will convince project leaders to provide review services, will persuade authors to seek reviews, and will serve as a handbook for reviewers. Realizing that reading time is a scarce commodity, we suggest the following strategies for economical reading of this book based on the reader's role and interest. Chapter I should be read by everyone; in addition, project administrators should also read sections 5, 7-13, 15; authors should read sections 3, 6, 8, 10, 11, 14; reviewers should read sections 3-6, 14, 15, and chapters IV, V, VI.

We wish to acknowledge the help of many people in the preparation of this book. A special thanks goes to Jim Krakower and Susy Soung who kindly supplied samples of their reviews for inclusion in this work. Thanks are also due to the rest of the MTC staff for reviewing this manuscript. Many members of the CERL staff (especially R. Allen Avner, Pauline Jordan, and David Meller) carefully edited this book and

suggested significant clarification to the ideas presented here. We are grateful to the remote site ARPA/PLATO authors (particularly those at Aberdeen Proving Grounds and Sheppard Air Force Base) who have cooperated with the MTC group during the development and codification of the review process.

Pat Thomas not only typed the manuscript, but contributed many invaluable suggestions on both format and content.

Finally, we would like to thank Rosanne Francis and Jerry Sweeney for their constant encouragement.

Chapter I - Lesson Review

A lesson review is a set of comments about a lesson prepared by someone other than the author as an aid for revising the lesson to improve its instructional effectiveness. A review may include suggestions about the programming, instructional design, and/or content accuracy. It entails considerations as major as the organization or the teaching strategy and as minor as grammar or punctuation.

This chapter is designed to give you a very brief overview of what a lesson review is so that you have a general background for chapter II which describes how to review a lesson. A more complete and specific view of lesson review is found in chapter III.

1 - WHY HAVE LESSONS REVIEWED?

Briefly, here are three reasons for having a lesson reviewed.

- Few people are perfectly balanced in the skills needed to write a lesson (e.g., subject matter expertise, programming skill, instructional design). Everyone can use some help.
- Even an extremely well qualified author loses his objectivity about a lesson after working on it for many hours and days. Though student data is useful for pointing out problems and new perspectives, there are some types of difficulties that student data will seldom reveal.
- Feedback based on current or recent lessons produced seems to be an efficient and useful author training technique. Presently, only limited instructional material directly related to topics such as instructional design for computer-based education (CBE) is available.

2 - WHAT KINDS OF REVIEWS CAN BE PERFORMED?

We distinguish between three types of reviews: subject matter, coding, and instructional design. The categories overlap slightly.

SUBJECT MATTER REVIEW

A subject matter review is concerned primarily with the content accuracy including terminology, drawings, concepts, etc. Of necessity, only a subject matter expert can do this kind of review. This type of review will not be treated explicitly in this report, although many of the comments are relevant.

CODING REVIEW

A coding review examines the efficiency, accuracy, and overall quality of the programming. This also includes the completeness of documentation such as the use of -define-, sensible -unit- and -area- names, and other similar considerations often called "software engineering." Depending on the kind of programming involved, a coding review may or may not be warranted. We feel that occasional coding reviews can upgrade the programming capabilities of newer authors. This topic is dealt with only briefly in this book.

The third kind of a review is known as an educational or instructional design review. This is the type of review in which the MTC group is most interested and experienced. In this paper when the term "review" is used without specifying type, we are referring to instructional design review.

A standard though relatively minor element of an instructional design review is the detection and correction of technical errors -- errors in grammar, punctuation, spelling, etc. Some courseware development groups have staff members whose duties are nearly identical to those of an editorial assistant.

Another part of the instructional design review seems almost as if it should be part of the coding review. When reviewing, we typically find it necessary to examine the coding for the judging or answer processing. Errors here can mean inaccessible help sequences, improper feedback, and misjudged responses. For example, we once found the following coding:

```
answer    .375
wrong     3/8
write     Your answer must be in decimal form.
```

Programmed in this way, the author's program happily accepted the fractional form of the answer. Unless he collected and examined the "ok" responses for some student who happened to use the fractional form, the author might never discover his error. Examining the code is the easiest way to detect this kind of problem.

Details about other concerns of a reviewer are the most important and yet the most difficult to categorize. Chapter

II expands the following brief list of considerations:

- prerequisites
- objectives versus test items
- sequencing
- tone
- interaction
- questioning
- feedback
- displays
- individualization

Instructional design reviews may be done during lesson development or after the lesson has been completed.

In-Progress Reviews

In general, we prefer to review a lesson several times during its development. This avoids the problem of the author getting so far along that the reviewer's comments cause time-consuming revisions. This type of reviewing also reduces the amount of criticism an author receives at one time. Often the initial plans, the objectives, the criterion test, and each segment of the lesson are reviewed successively. In-progress reviewing is discussed in detail in chapter V.

End-of-Lesson Reviews

Although in-progress reviews are generally preferable, sometimes they are not feasible. Until an author has confidence in the reviewer and has a working knowledge of what a review is supposed to do, it is difficult to convince him to submit an unfinished lesson for review. So, some end-of-lesson reviews are

stepping stones to future in-progress reviews.

In-progress reviews are only possible if the lesson is in the process of being developed. In several instances this is not the case. The author may have finished the lesson some time ago, the lesson may belong to someone who has left the PLATO system, or the lesson may be borrowed from another curriculum development group in order to revise it for a different audience. In each of these cases, an end-of-lesson review is appropriate. Details about the special needs and procedures for this kind of review are given in chapter IV.

One last admonition: one might tend to view the distinction between end-of-lesson and in-progress reviews as summative versus formative evaluation. Though there may be some parallels, this comparison is basically inaccurate. Both types of review are formative; both pre-suppose modification of the lesson materials following the review.

Chapter II - Performing a Lesson Review

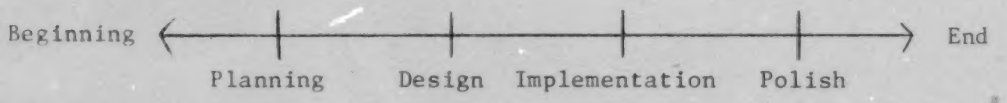
Much of the material contained in the following sections was influenced by Lesson Review: Some Suggestions, which was developed by Merle Goldstein as part of a project for her Master's degree while she was working with MTC. Chapter II, in particular, with some minor changes has been taken directly from Lesson Review.

The following chapter was designed to be used to review any packaged lesson or lesson segment. A packaged lesson is one that is basically free-standing, self-presenting, and capable of being administered identically each performance. Programmed instruction, CBE, and films have all been reviewed using the techniques described in this chapter. It is implicit in this and successive chapters that the author is not present while the reviewer is going through the lesson. This both saves the author time and prevents situations in which either the author feels he must defend the lesson, or the reviewer's objectivity is hampered by the author's presence.

3 - HOW IS THE REVIEWING TASK STRUCTURED?

Part of the difficulty in preparing a review is deciding on its focus. What kinds of comments are most useful? Where should one put the most effort?

It is a little easier to answer these questions if one has an organized "picture" of the different kinds of comments it is possible to make. One useful way of thinking about these different kinds of comments is to imagine them as running along a continuum going from those concerned with the fundamental structure of the lesson to those concerned with the lesson's "polish." These comments can be thought of as belonging on four different levels:



LEVEL ONE -- PLANNING

Comments on this level concern preliminary fundamental decisions made during the planning stages of a lesson. For example:

- The intentions, goal, objectives of the author -- the purpose of the lesson
- Assumptions made about the student's general ability and specific background in the subject
- The relationship between a particular lesson and the course or curriculum of which it is a part
- Exactly what content to include and exclude from the lesson -- what content should be selected

LEVEL TWO -- DESIGN

Comments on this level concern decisions made about the design of the lesson. For example:

- The choice of particular teaching strategies
- The selection of media
- The way the lesson will handle students with heterogeneous backgrounds and abilities -- the extent of individualization and differential routing
- The organization of the content

LEVEL THREE -- IMPLEMENTATION/DEVELOPMENT

Comments on this level are concerned with how well the previous decisions are carried out. For example:

- How well the chosen teaching strategies and media are being employed
- How well the lesson handles individual differences in corrective feedback and remediation
- The appropriateness of the lesson's tone and style
- The lesson test, if any
- The lesson flow -- e.g., how smoothly frame-to-frame and topic-to-topic transitions are made
- The quality and quantity of student interaction -- e.g., is enough practice provided, is there substantial material the student is not actually required to use in some way during the lesson
- The appropriateness and quality of the questions -- e.g., are they aimed at the proper skills, are they technically sound
- The clarity of the explanations, the appropriateness of the reading level, the illustrations, and the examples

LEVEL FOUR -- POLISHING/FINISHING

Comments on this level concern editorial, aesthetic, and production issues. For example:

- The language -- e.g., grammar, spelling, typographical errors, etc.
- Consistency in the use of terms, instructions, keys, etc.
- The technical quality of the lesson as a graphic production -- e.g., margins, spacing, indentation, accentuation, etc.
- The aesthetic appeal of the lesson

One of the first things a reviewer must do is decide how many and which of these levels he will include in the review.

In general, a good rule is to concentrate first on problems at the more basic, structural levels (that is, levels one, two, and three). Not until after the problems at these levels are cleared up is there much point in dealing with problems at level four. One reason for this rule is that if the reviewer is questioning something at a relatively basic level, there is less need (or time) to deal with the problems falling into level four. For example, if one doubts the need for a certain segment of the lesson, there is nothing to be gained by pointing out that a word within that segment was misspelled. An exception to this rule is that when a specific kind of problem crops up again and again within a lesson it is helpful to point that out to the author no matter at what level the problem occurs. For example, if a word is consistently misspelled, it would be worthwhile to mention.

Finally, it is important to note that this leveled approach becomes inoperative when the author of a lesson specifically requests comments of a particular kind -- unless the reviewer is in a position of authority that allows him to insist upon the need for comments at all levels.

4 - WHAT ARE USEFUL REVIEWING PROCEDURES?

MULTIPLE PASSES

It is horribly inefficient to look simultaneously for all the different kinds of problems a lesson might contain. Described below is a procedure that is more efficient.

First Pass

First impressions occur only once.

- Get a general impression of the lesson -- identify for yourself what your biases are concerning the lesson.
- Set up "flags" as to where (at what levels) you are going to focus your attention.
- Take notes concerning what goes through your head as you work your way through the lesson. Write down <u>everything</u>. (Remember, first impressions occur only once).

Second Pass

- Note your <u>perceptions</u> as to the objectives of the lesson.
- Note your <u>perceptions</u> of what assumptions the author is making concerning what students already know.
- Take brief notes on all the information (i.e., the lesson content) that the author presents to you -- or rather to the student whose role your are simulating.
- Work through the lesson as both a "smart" and a "slow" student in order to see how the lesson handles both.
- Note your perceptions as to the organization of the lesson. This is the time to make an outline of how

the ideas flow and to attempt to depict the branching. This is a roadmap of the lesson and should be compared to the flow chart of ideas that the author supposedly sent along when he requested a review.* They, of course, should match exactly. That is, the ideas in the lesson along with the available help and review sequences should be exactly as the author has claimed.

Third and Additional Passes

- Use these passes to take a closer look at specific segments about which you have questions and, if appropriate, to look at the coding of answer judging. If you are working through the lesson with the printout, follow the flow of the lesson on the printout as you go through the lesson.

WRITING YOUR COMMENTS

Having gone through the lesson and taken notes concerning your reactions to it, you are now ready to synthesize your remarks and to organize all your material in order to prepare a report for the author.

Depending on your style and the strategies employed by the lesson, your written report might include the following parts:

- A letter or other introduction to the review
- A section devoted to your general comments covering the conclusions you reached based on your observations (which have been documented in the materials mentioned above). Such a section could include a comparison between your observations and the author's

---

*See section 6 for a discussion of what items an author should supply the reviewer.

stated intentions as well as a statement concerning how consistent the different elements of the lesson are. In a sense, this section would be devoted to comments related to levels one and two and some comments related to levels three and four that come up again and again in the lesson.

- A section devoted to your specific comments concerning particular segments of the lesson -- i.e., the detailed criticisms and suggestions. If you're working with a printout, it is generally useful to write these specific comments right on the printout itself.
- Sections detailing information the author failed to furnish you with or which seems incomplete or incorrect.
  - A content outline sketching the subject matter as you perceived it.
  - A list of the assumptions that seem to be made in the lesson.
  - A flow chart sketching your perception of the routes a student can follow as he works through the material.
  - A list of the subskills which are implied in the lesson's objectives.

SUGGESTED TECHNIQUES

The techniques listed below can be grouped according to the levels of review discussed. Not all techniques are applicable to all lessons, of course. They may, however, serve to get you going, giving you some ideas for developing techniques of your own.

Level One -- Planning

- Objectives Note the author's intentions as stated in

documents, in the lesson, as implied by the title, etc. Indicate your perceptions of the student and lesson objectives based on working through the material. If your perceptions don't match the author's apparent intentions, question him as to which truly reflect his wishes. Make suggestions as to possible changes in the stated objectives or in the lesson.

- Content Record your perceptions of the content of the lesson -- in most cases, this would involve writing down the information presented to the student. This might be prepared as a content outline or as a list of concepts. Compare this outline with the objectives (as stated by the author and as perceived by you). Note which objectives the outline seems to support. Compare your content outline with any documented listing of intended content as supplied by the author. Note inconsistencies between content and objectives (as observed or as stated by author). Make suggestions as to changes in the content of the lesson.

- Assumptions Record your perceptions of what assumptions the author has made about what the students already know and can do. Compare these to a profile of the target student population or list of entering behaviors of the students. Point out inconsistencies or, if no description of the target population exists, call the author's attention to your list of perceived assumptions to see if he agrees with your perceptions. If necessary, suggest that a series of diagnostic tests be developed to provide some information concerning students' entering behavior. Suggest additions or deletions of material based on the above.

Level Two -- Design

- Teaching Strategy Compare the instructional techniques

(e.g., tutorial, drill and practice, simulation, inquiry) with the objectives as perceived and stated. Note whether they "fit" each other. Suggest possible changes in technique and/or reappraisal of the objectives in view of the strategies employed.

- Sequencing Note the routing procedure used (linear, branched, fast-slow tracking, etc.). Prepare a flow chart of the lesson. Compare with student profile and flag possible problem areas. Analyze student data or advise the author about areas that should be watched especially carefully when students go through the material. Point out those sections where the author has used branching most skillfully.

- Organization The content outline can be used to document the perceived organization of the material in the lesson. Note whether there is a clear structure and/or a smooth flow to the material -- i.e., are the relationships among concepts clear? Does the arrangement of the subject matter seem confusing?

  Note the educational strategy being used in the lesson. Is it consistent with the objectives and/or the student profile? Suggest changes and give appropriate compliments.

Level Three -- Implementation/Development

- Student Interaction Indicate what interaction is involved -- i.e., what skills the student needs to successfully interact with the computer: perfect spelling, fast typing ability. In some lessons we've reviewed which used gaming to motivate the students to learn some rote material, the games were so complex that learning the rules required a higher skill level than did the lesson material itself.

  Compare the type and quantity of interaction with the objectives, content, student profile, level of

mastery, and the questions on the criterion test (if present) that accompanies the lesson. Note any inconsistencies, but reinforce sound practices too.

Outline the relationship between the content (information presented to the student) and the interactions required of him in the lesson. For example, note whether the student is provided with all the information he needs to answer questions. And note whether the student is actually required to demonstrate the skills specified in the objectives. The objectives may, for example, specify that the student state a definition; the lesson, however, may only ask the student to choose the best of four supplied definitions. This kind of problem is frequently found.

Determine how the author handles individual differences in response to questions. Note how he handles feedback and remediation. Do different responses evoke different feedback? Do successive incorrect responses elicit ever stronger hints? Can a student go through a lesson without learning the material because the lesson always gives him the answer on the third try?

Note how much practice the student is provided and how it is provided (i.e., massed or distributed). Compare the amount of practice with the level of mastery to be achieved. Analyze the questions (in the lesson and in the test) and, if necessary, note violations of good question-writing techniques. Norman Gronlund's Measurement and Evaluation in Teaching (1971) and Norris Sander's Classroom Questions (1966) are good standards for question construction. Compare the type of question used with your perception of the objective the author is trying to test at that point.

- Presentation Determine whether the author is using the instructional techniques and the medium

appropriately. Look at the text as a book reviewer, the animations as a film reviewer.

Note the overall tone of the production. Are remedial work and feedback condescending? Compare the tone with the student profile, the context, the objectives, the subject area.

Note the author's attempts (or lack of them) to keep the students motivated. Compare with what is known about the reasons the students are working through the materials. Make suggestions as necessary and congratulate the author when his lessons seem particularly promising.

Note the author's attempts at directing the student's attention to important material and, in general, helping the student find and work with the material to be mastered. Suggest capitalization, underlining, boldface lettering, spacing boxes, or arrows, if necessary. Inspect the explanations to determine if they are clear. Check to see if there is any jargon or convention with which the student might be unfamiliar. Determine whether the illustrations are being used to the fullest advantage.

Level Four -- Polishing/Finishing

- Determine whether the lesson is in good enough shape to undergo a final polishing. If not, concentrate on levels one, two, and three. If it is, proceed with the final editing. Note whether the materials are technically satisfactory and whether the lesson is aesthetically pleasing.

SUMMARY

There are six types of information the author finds in

a review of his lesson.

- He finds out what the reviewer considers well done. This is an important part that is frequently forgotten by reviewers. It makes the review more palatable and increases the likelihood the author will request a review in the future.
- He finds a list of errors and problems which he did not anticipate or which he dealt with unsuccessfully.
- He finds proposed solutions or suggested resources which can aid him in correcting problems.
- He gets a list of potential problems needing more data. These are items which the reviewer is uneasy about but lacks the experience or data to definitely label as problems.
- He gains a perspective as to how his lesson looks relative to other lessons.
- He finds that the reviewer needs clarification of such items as the purpose, use, or design of the lesson. These can be resolved during future interactions with the reviewer.

A chance for you to practice using these skills is provided in chapter VI. A segment of programmed instruction has been "seeded" with a number of errors which you are to locate. A list of known errors, categorized by level, follows the practice exercises.

Chapter III - Reviews of Computer-based Instruction Lessons

This chapter describes special aspects of reviewing CBE lessons, rationale for lesson standards, how to select a reviewer, various uses for a review, how reviews relate to student testing, reviewer responsibilities, etc.

5 - WHAT FORM SHOULD THE REVIEW TAKE -- WRITTEN OR ORAL?

Some parts of a review should be written; others are best delivered orally. The general comments about the lesson should be written (preferably typed).

WRITTEN

Comments should, of course, be kept as part of the documentation of the lesson. A written document is harder to ignore than oral comments. One cannot simply forget (selectively or unconsciously) some of the more unpleasant suggestions. The permanence of a written record is helpful in that the author can re-read the comments to extract their full meaning, or he can show the review to colleagues for their opinions. Also, many people have a useful hang-up about discarding personal, typed correspondence -- they are likely to file it. It's useful for the author to be able to look at the review a few months later when he has gained more experience with the lesson. In retrospect, he may better observe his "blind spots" or may find the reviewer's perceptions were inaccurate.

End-of-lesson reviews may be typed and mailed; in-progress reviews must be delivered faster. With PLATO's aid and a hardcopier or printer, the reviewer can write his comments on-line to speed communication. A hardcopy of the comments should then

be obtained by author and reviewer for a permanent record.

ORAL

Though we're biased towards written reviews, we feel there is an important role for face-to-face or on-line communication in reviews. The personal interaction can serve to direct the review, to soften criticism, and to act either as an introduction to the written review or a follow-up to it. In a later section we expand on the idea that even an end-of-lesson review should not be a one-shot process but should serve instead as the beginning of an interaction.

RECORDINGS

The MTC group has considered, but not implemented, one interesting reviewing format. We contemplated using a stereo tape recorder to record the computer-to-terminal input in one channel while simultaneously recording the voice of the reviewer in the second channel. The method lacks certain desirable features of the written review, but offers a great deal for lessons which contain complex animations or involved simulations. Only the difficulty in finding a portable stereo tape system available to both author and reviewer has prevented implementation. The "talk" option's monitor feature provides much the same type of interaction as the taping method proposed above. However, "talk" lacks permanence and information on tapes is difficult to index or retrieve. For these reasons, tapes and on-line conversations must be accompanied by written comments.

5 - WHAT SHOULD THE AUTHOR PROVIDE FOR THE REVIEWER?

Most of the following items should already be a part of the author's notebook or documentation for the lesson.

- A description of the student population.
- The overall curricular plan and where this lesson fits into it -- the lessons' prerequisites.
- The lesson objectives. These may be different from the student objectives. For example, a lesson objective might be to arouse a student's curiosity about a topic (i.e., a lesson objective may be attitudinal).
- The flow chart for the student branching in the lesson, (not a programming flow chart). We feel that a simple flow chart should be drawn at the lesson's inception and kept up to date as the lesson develops. We prefer a flow chart made of boxes or circles connected with arrows showing briefly the lesson's content and branching. Nothing elaborate is needed. For example, see page 79.
- Any handouts, workbooks, worksheets, or supplementary material which accompany the lesson. Also the slides or audio disks that are used by the lesson.

The following items are useful, but not always necessary.

- The lecture notes, text, films, and other teaching materials which are replaced by the lesson or from which the lesson is drawn.
- A variable map if (Heaven forbid) -define-s haven't been used or if the lesson is unusually complex and a code review is desired.

- Student data, if available. An on-line copy of the datafile is very much better than a printout since it can be computer-searched.

The author should note how the trial students differ from the target population (prerequisites, ability, etc.). Unfortunately, most reviews have to be undertaken with only two or three of these components present. The more items that can be acquired, the more complete and accurate (and less time consuming) the review will be.

There are several steps that the reviewer may take to make his job easier. If the reviewer copies the lesson into one of his own lesson spaces, he won't be bothered by continual debugging by the author. To this copy he may add this special "imain" unit:

```
unit      imainu
at        101
showa     mainu     $$this shows the name of the main unit
*                   in the upper left hand corner of the
                    screen.
```

He can also insert any extra -term- commands needed to facilitate movement within the lesson. The following code is added to the initial entry unit (ieu):

```
imain     imainu
*list     commands,jump,jumpout,next,nextnow,back,lab,data,
          help,end,term      $$these last two lines should
                             be added if working with a
*                            printout.
*list     symbols
```

The -list- commands are only needed if the reviewer is working with a printout. When a printout is made, these commands provide

the data for the reviewer to construct a student branching flow chart if the author has failed to provide it.

7 - IF REVIEWS ARE SO GOOD, WHY DOESN'T EVERYONE DO THEM?

OTHER MEDIA

Depending on your definition, everyone does reviews! Lesson reviews or their analogs are everywhere. Calling them "reviews" is actually a semantic problem; they're really "edits," something found in the publishing industries. In PLATO jargon, however, "edit" and its derivatives have another connotation and so the word "review" has been used. Because of the differences in media, the parallels with the editing process as practiced by the editors of textbooks and movies are not as obvious as one might expect. A movie editor may cut and splice but can rarely reshoot film. The book editor has an even more restricted medium; he cannot control speed, flow, or tone. Both media are linear, non-interactive, and non-individualized. The objective of all editors (including lesson reviewers) is, however, basically the same: to help the author provide a clear, coherent, organized flow of information in order to impart knowledge or achieve an effect.

In the past, most PLATO lessons were reviewed only informally.

Standards are available for editors of the printed page; standards for film editors seem to be less well-defined, more artistic. This is reasonable since motion pictures are only 75 years old whereas printing is 500 years old.

Both media have professional editors; however, they are not the people who have written the material.

THE PAST

In the past it was not a general practice for PLATO authors to have their lessons formally reviewed. This is hardly surprising. During PLATO III days, classes were necessarily small; few lessons had been written and little was known about the criteria by which to judge a lesson. Standards were just emerging. During those days, too, it was possible for an author to know most of what was known about writing PLATO lessons. All authoring took place in one room. "Old timers" (those who had more than one year of experience) generally knew all PLATO authors and (amazingly!) all lessons currently under development. With easy access to lesson names and the capacity to store only two to four lessons at once, authors waiting for space typically entertained themselves by going through someone else's lessons. In this manner they learned CBE teaching techniques. Furthermore, such authors typically gave and received unsolicited comments about execution errors and instructional strategies based on this experience.

With the PLATO system in its infancy, careful, expensive reviews were probably not as necessary. The lessons were experimental, the audience small, and the system constantly changing.

THE PRESENT

The implementation of the PLATO IV system brings great

opportunity and new responsibility. The wide geographic distribution of terminals means that many new users are having to rediscover the techniques, tricks, and skills for writing good lessons. Justifiable security measures and the formation of author subgroups mean that there are fewer chances for the novice to see a lesson being produced by an experienced author; generally only finished lessons are exhibited. Because of the proliferation of authors and lessons, no one can keep a friendly eye on each new author and lesson. When comments on a lesson are requested in "notes" the respondents are likely to be brief and general. With little personal liability at stake and no guarantee of reciprocation, there is little responsibility to do a thorough job.

Thus, at present, most reviews are done informally or not at all. Some of the larger curriculum development groups have a step in their instructional development process which contains many elements of a review as described by this report. Only a few of these groups produce any written remarks and most of these deal with subject matter or coding rather than instructional design. It seems that content and coding "errors" are more easily found, proved, and corrected than are instructional design problems; furthermore, people tend to be less familiar with the educational aspects of lessons.

Compared to those for more commercial publications, the standards for textbooks and other educational media (records, tapes, films) seem to be low. The first editions of many science texts (which include many figures, graphs, and chemical or mathematical equations) contain staggering numbers of errors. Some

are typographical -- missing minus signs, decimal points, etc.; others are scientific misconceptions. Taken as "gospel" the scientific errors may be propogated by other authors. For example, The Journal of Chemical Education prints a column called "Textbook Errors." Although an error must appear in more than one text to qualify as publishable, this column has virtually become a regular (monthly) feature.

To summarize: (1) things like reviews are done formally in other media, (2) informal reviews have been done in CBE for some time, (3) CBE is considerably newer than other media, and CBE standards are less well established at this time, (4) the amount of energy devoted to reviewing should reasonably depend on the type of use and the size of the audience, and (5) the quality of other educational media is not consistently high.

3 - WHY MUST AN OUTSIDE AGENCY OR PERSON LOOK AT THE LESSON?

An outsider can be more objective and may have more reviewing expertise than an author or a co-developer.

OBJECTIVITY

Initially it would seem that the author always knows best -- he conceived the lesson, he can feel the objectives at a gut level, he knows every twist, turn, and subtlety in the lesson. He has tried and discarded various approaches, strategies, and test items. How could a reviewer have any useful comments unless he too had undergone the trials and tribulations of developing that lesson? Why not let students find the error?

Overdramatic? A bit. But some authors have exactly this reaction. In accomplishing what is a rather difficult task -- giving birth to a lesson -- they may have become so involved in the lesson that they have lost their objectivity. For example, an author may begin to write the lesson to follow the style in which he goes through it. To a great extent the author loses his objectivity about details large and small by "wearing a path" through the lesson. He always puts in the same right and wrong answers and thus loses his ability to "proofread" the lesson for various student responses. In this way, a PLATO lesson is somewhat like a toy which "works" only the first time each person tries it (e.g., the "candy can" full of springs): the

designers or other people who know "the answer" can no longer perceive and react to a lesson as a student would.

Though one of the advantages of a team authoring approach is the greater objectivity of members of the team relative to each other, team authors may also lose their perspective. Hence, when it comes time to review the lesson, an "outsider" may be necessary. To remain an outsider, the reviewer must, at first, be ignorant of the author's approach and strategy. In general, the reviewer should be able to approach the lesson very much like a student would by "knowing" only as much as the lesson prerequisites specify.

EXPERTISE

In addition to the fact that a developer may not be objective about his own lesson, another person may have greater reviewing expertise. According to the experience of the MTC group, one might say a "good" reviewer is both born and made. All reviewers seem to develop continually and substantially with experience. Thus, there may be someone to whom the developers can turn who would be expecially willing and/or able to review a lesson. The subject of who should review a lesson is considered in section 11.

9 - WHAT CAN YOU DO WITH A REVIEW?

EVALUATION

As an administrator you might use the lesson review as an evaluation. You could use it to decide to hire or promote an author, to use or discard a lesson, etc. That's not really the purpose of the review process as we have outlined it. It is very dangerous to use a device designed to do one job to satisfy a different purpose. We would agree that many of the techniques and guidelines given in this paper would be useful for developing an evaluation of curriculum materials. However, several problems arise if a critique is to be used both as a review and as an evaluation.

If the author realizes he is going to be evaluated by a lesson review, the usefulness of the review is largely nagated. In order to obtain a satisfactory evaluation, the author is forced to put his lessons in a complete and polished form before asking for the review. By the time the lesson is polished, the author has a great deal of ego invested in the lesson and he may find it hard to accept suggestions to change it. He is forced to be defensive with respect to the reviewer and his cooperation is likely to be dependent on how he feels the evaluation will come out. On the other hand, the amount of cooperation he provides may affect the evaluation. In general, he has a conflict of interest. He can't relax with the reviewer, nor can he request the

review when it is most needed -- at an early, unfinished state -- when the lesson is full of unresolved problems. Rather, he must muddle through alone and then defend his solutions.

REVISION

How about using a review as a tool for revision of the lesson to improve its effectiveness? This is exactly what a lesson review is for. It should be designed so the author can choose the items which he and the reviewer agree on and go directly to the lesson and implement the changes. In fact, with a review and a well documented lesson, any programmer should be able to begin revision with little delay.

A lesson review may also be used to revise a lesson written for a different audience or with different objectives. Such a case may arise when a course is re-designed or when a lesson is borrowed from another institution.

TRAINING

Lesson reviews have been put to good use as training devices. By examining reviews of other lessons, a new author can learn what typical sorts of problems he should avoid. A number of authors have found this to be a more convincing and less tedious way of learning many instructional design principles compared to reading about contrived examples or perusing lists of "do's" and "don'ts."

It is to everyone's advantage for the head author at a site to request and utilize reviews regularly, setting an

important precedent by showing that even well-respected authors need and accept critique. This makes it easier for less experienced authors to request and accept criticism when their own lesson is reviewed.

FUTURE

Finally, a review may be useful even if the lesson is never revised. Although we encourage revision, it is nevertheless true that the reviewer may suggest a change that is so massive or difficult that the author feels he cannot afford the time to make the revision. However, when writing future lessons, the author can take note of and observe the reviewer's suggestions.

10 - WHAT IS THE RELATIONSHIP OF REVIEWING TO STUDENT TESTING?

Is one better than the other? Does one come before the other? Why do both since they seem to have the same purpose?

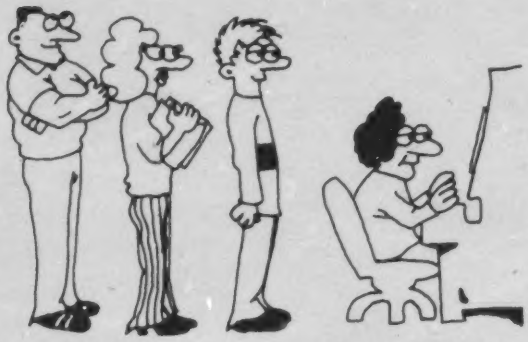
MISCONCEPTIONS

It is a common misconception that student testing will reveal all of the important shortcomings of a lesson. Though it is true that, in general, student testing is used far too little and typically too late, there exist several types of problems that even a perceptive author using critical students will often overlook. Several of these types of problems are associated with objectives. For instance, students are seldom aware when they are not being tested on all the objectives of the lesson. More subtlely, many authors consistently test only with recall items, when the objectives or the career performance requires a higher level of thought -- such as analysis, synthesis, or problem solving. Another problem is that since a student generally goes through a lesson only once, he is generally unaware of and thus insensitive to alternative branching schemes.

Military students may find it difficult to comment negatively about a lesson.

Even when students can detect problems, they can generally only indicate symptoms rather than diagnose the problem and recommend a cure. Furthermore, because of the rank and roles implied

by the student-teacher relationship, military students (and perhaps students in industry) may find it difficult to comment negatively about a lesson. Since students generally go through a lesson only once, it is difficult for them to be both learners and critics simultaneously.



Some people feel that testing with enough students is sufficient.

While aware of these arguments, some people feel nevertheless, that testing with enough students is sufficient. In addition to dangers already pointed out, there is a further problem. Running a large number of students as a debugging technique requires rather extensive amounts of time devoted to analysis of student performance. Although a great deal can be learned from working through all the responses collected from ten to twenty students, the same procedure applied to fifty or more students produces more boredom than information because of the large amount of redundancy. Thus, if all the previous arguments have failed to persuade the author of the benefits of review, perhaps he can view it as an alternative to the decreasing return he gets from running more students.

ORDER

If one is convinced that reviews and student testing are both necessary, there arises the question of which should be done first. Coding reviews should be done with some definite purpose

in mind and that purpose dictates when the review should be done. Subject matter reviews should normally be made just before the first major student test. In-progress instructional design reviews occur during development. Hence, the only ordering that is prone to much controversy is when to make the end-of-lesson instructional design review. The end-of-lesson review should precede student testing if the student's time is very expensive or if the pool of students for actual use is small and must remain "uncontaminated.". The latter situation sometimes arises when doing educational psychology testing. In the above cases the reviewer serves in a sense as a "guinea pig." He smooths the rough edges of the lesson and conserves the precious resource, students, for final polishing. Again we stress, however, that a reviewer is only a partial replacement for real students.

In nearly every other case, the end-of-lesson review should follow the first student trial. Though we of the MTC group have never performed a review with student performance data at hand, we would prefer having students try the lesson first: any obvious mistakes, embarrassing to the author, can be eliminated before the reviewer sees the lesson. Also, after evaluating performance, the author has a basis for "aiming" the review. That is, he may ask the reviewer to solve a particular problem.

For the following reasons we feel the author would have a better psychological "set" for accepting criticisms from the reviewer after running a sizeable number of students.

- Either the author knows the lesson has problems and appreciates the reviewer's help or he knows it is fairly good and isn't crushed by the review. In the first case, the author shouldn't react negatively to the reviewer. In the second case, the author should more easily recognize the review for what it is intended to be -- suggested improvements to a viable lesson.

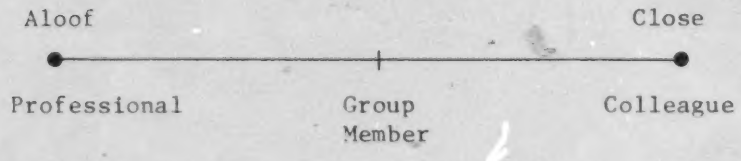
- Student data can aid the reviewer to find problems in the same way it can help the author. The reviewer may be more experienced at interpreting data and may find additional problems as well as teach the author how to "read" student data. The reviewer's task of convincing an author to make a change can often be simplified if the student data supports and justifies the reviewer's comments.

- Though a check on the data collection programming is part of a review, the check is best made by attempting to follow the progress of real students and by trying to evaluate a student only on the basis of the information which was put in the datafile.

11 - WHO SHOULD REVIEW LESSONS?

We stated earlier that the reviewer should be an outsider with respect to the development of the lesson being reviewed and that the reviewer need not have mastered the lesson material. That still leaves unanswered many questions about selecting a reviewer. Let's look first at the question of what an "outsider" is and then examine the reviewer as a person (section 12).

Three categories spanning the range of closeness-aloofness seem useful. At one extreme we have the "professional" reviewer, in the middle there is a member of a course development group, and at the other extreme, a close colleague. Experience, objectivity, perspective, and formality are traded off between the different "levels" of reviewers.



THE PROFESSIONAL

The "pro" is somewhat akin to a journal editor. He is less likely to be biased by friendship and personality traits. In fact, he may be working with authors whom he doesn't know. Furthermore, he is likely to see enough lessons to have an excellent feel for what is good, what is not good, and precisely how to make improvements. As an expert, he is probably especially

fast and efficient in reviewing.

He faces problems however. Feedback from an author about how the review was received and how useful it was is difficult to get. With anonymous reviewing, it is hard to clarify points of confusion or receive answers to redirected questions. Even without anonymity, novice authors are unlikely to openly challenge the "expert's" opinion. In this role there is a danger that the reviewer would grow to be hypercritical, as drama critics seem to many people today. Lacking feedback from the author, the reviewer is unable to see the effects of his suggestions. Suggestions that are rejected or that fail to cure problems cannot be detected with such feedback.

If the professional reviewer and the author have met at least once face-to-face, there seems to be an increased chance for good rapport. The reviewer gets a chance at a quick size-up of the author and can briefly explore his background, experience, and temperament. The friendship can be continued fairly easily over the terminal once the initial face-to-face contact has been made.

GROUP MEMBER

Compared to the "pro," the member of a courseware development group who is appointed "reviewer" has several advantages. Like the "pro," he has a clear role and responsibility and will gain enough expertise to turn out a consistent, high quality product and enough experience to measure lessons by broadly-based standards. Because he knows the goals of the lessons and project,

the target population, and the project background, he can be quite efficient. This familiarity means that his comments can be more specific and he can adjust them to fit the personalities of the authors. Hopefully he can strike a good balance between maintaining his own objectivity and bruising the egos of the authors. His comments may find easy acceptance if the responsibility for a quality lesson is perceived by members of the team as a shared responsibility. However, depending on his formal and informal authority within the group, he is not usually in a position to enforce revision according to his review.

THE COLLEAGUE

The most typical sort of reviewing that goes on at present is done between a pair of close colleagues, often officemates. Such relationships, when backed by mutual trust and friendship, can help both participants to grow rapidly. By doing reviews of his colleague's lessons, each author can more easily accept a review of his own lesson. There is a commitment to implement or to "argue out" proposed changes and, in general, feedback of all kinds is easy to get. To maximize feedback the two members should be approximately equal in position and experience. Though they may not share final responsibility for the lessons being produced, the reciprocating nature of the involvement tends to keep the review careful and thorough. Another advantage is that such reviews are often "continuous": the lesson is reviewed at various stages of development (even before anything goes on-line). Because of this, less author ego is involved. Unfortunately, few

of these reviews are recorded formally and, hence, much of the effort may be wasted because of forgetfulness.

SUMMARY

The description of the three levels of association between reviewers and authors suggest that there is no clear answer as to which is best -- each arrangement has its own advantages. The best situation is a combination of all three. (All three types of review for every lesson would, of course, be too expensive.) Authors should pair up to review each other's lessons during development. Each lesson should be examined by the group's reviewer in order to maintain a consistent style and tone throughout the group's lessons. Finally, the group reviewer can send off especially good, bad, or difficult-to-review lessons to the "pro." In this way, the group reviewer grows professionally and acquires a broader view of lesson quality. He also has a mechanism for finding and sharing new ideas as well as calibrating his own work.

The important changes are really made to authors, not to lessons.

Finally, the kinds of changes that any type of reviewer is likely to be most successful in getting the author to make are the least important ones: cosmetic changes to display, technical corrections, programming errors. Since our staff works mainly with inexperienced authors with little or no education background, our reviews are directed not only at specific lesson

problems, but at building a more long-range educational perspective.

The important changes are really made to authors, not to lessons. Influencing authors to use more indiviudalization and better questions is important. Introducing them to the concepts of mastery learning and taxonomies of learning is important. Lesson review can be an end in itself, but more importantly it is a means to expand an author's horizons. It is difficult to influence an author's philosophy by giving him a few typewritten pages. No single lesson review can cause these major changes. However, a series of reviews, coupled with student performance data, have caused significant changes in receptive authors.

12 - HOW DOES ONE SELECT A REVIEWER?

BACKGROUND

In terms of background, there is no obvious curriculum or coursework that is necessary. Naturally, it is useful to have familiarity with the concepts and jargon associated with curriculum development, educational psychology, and educational technology. All of the reviewers who have worked in the MTC group originally lacked background in some of the areas listed above, yet all picked up the basic information; hence, don't weigh formal training too heavily. On the other hand, someone who is familiar with objectives, learning theory, and instructional design is likely to be able to find and justify problems with high efficiency and clarity after only brief training. Experience with so-called "packaged" instructional media like programmed instruction, video casettes, and CBE is rare but valuable. Persons who have tested such materials with students bring additional insight.

PERSONALITY

The personality of the reviewer is probably the most important criterion. In a technologically rich medium like CBE it is frequently easier to find staff who are task oriented. Many courseware development tasks can be superbly handled by the task oriented staff, but reviewing is not among them.

Acceptable personality traits may vary with the role and administrative structure, but several qualities are necessary. The reviewer should be humble, non-perfectionistic, and flexible. Critical reviews can be very damaging or discouraging to an author. Careful phrasing of comments can minimize the shock of a review. Sensitivity to the author's comments and feedback can reassure the author of the overall worth of his lesson. Because the reviewer may find himself in a position of only informal authority, respect and credibility play an important part in his success as a reviewer. These are earned by exhibiting competence in reviewing, but are also a facet of one's personality.

TRAINING

Next to personality, training is probably the most important aspect of a reviewer's success. As stated earlier, reviewers are both "born" and "made." The emphasis seems to be on the "made" in our experience. Knowledge gained by reviewing lessons grows at a terrific rate. By the time he has completed his third review, a staff member either has decided reviewing isn't for him or has learned so much he needs only minimal guidance in doing future reviews.

Three techniques allow the novice reviewer to quickly acquire the tools of the trade. Examining reviews done by other reviewers gives him pointers about typical lesson problems and, more importantly, the style and tone of a review. Secondly, an apprenticeship with an experienced reviewer is <u>extremely</u> desirable.

The experienced reviewer can examine the written work of the novice and prevent him from saying something that the author might find too critical or might misinterpret. Thirdly, feedback from the author about the review is necessary to refine one's techniques no matter how experienced the reviewer is. If possible, further information may be gained by examining the lesson a few days and weeks after the review. By examining the "last edited" data for each block and by working through in student mode, the reviewer can determine which comments were convincing and important enough to cause the lesson to be changed.

STANDARDS

The guidelines in chapter II were developed to assure that several important considerations and comparisons were made by all reviewers as well as to assure the delivery of a product conforming to minimal standards irrespective of the person performing the review. A high level of uniformity seems difficult to achieve, however. Different reviewers have different sensitivities. What is achievable are standards that specify types and levels of examination which are detailed enough to produce useful feedback to an author. Given the admitted situation of non-uniform reviews, one is tempted to request reviews of a lesson from several reviewers. The main disadvantage to this is economic: the thorough end-of-lesson review can take from 15-25 hours (including write-up); in-progress reviews can take from 3-6 hours.

13 - WHAT ROLE, RESPONSIBILITY, AND AUTHORITY SHOULD A REVIEWER HAVE?

This question arises most typically when considering a reviewer who is a member of a curriculum development group. In this position, the reviewer may assume a role either as an assistant to the project director or a member of the author support team (which might also include artists, photographers, editors, etc.). In the former role the reviewer is powerful, but he can become too evaluative. Further, his goals may be at cross purposes with those of other administrators (e.g., high quality versus high production). In an author support role he is easier for the authors to ignore, but is "on the author's side."

A second dimension of the reviewer's role is whether he should also be an author. A full-time reviewer may be seen by authors as living in an ivory tower -- unacquainted with the real world. On the other hand, extensive, ongoing lesson writing experience is not a co-requisite for good reviewing; our best reviewers have written few PLATO lessons.

No matter what the role, it is very important to give the reviewer responsibility for the lessons he reviews. The responsibility may be joint, that is, shared with the author, or advisory, that is, the reviewer's responsibility ends when his comments are delivered and documented.

No discussion of responsibility is complete without

discussing authority. Formal authority seems unimportant in reviewing: excercising it tends to lead to evaluative reviews. We operate, by necessity, strictly by informal authority. In our case, all requests for reviews are voluntary and we have absolutely no power to ensure that the reviews are read or used. In this situation, one must maintain a reputation for high quality work. Since our service is advisory only, it's easy for an author to stop asking for advice if a review is unsatisfactory -- as we have found. Necessarily, feedback from the author to the reviewer is critical in this situation. A phenomenon we have noticed might be called the "it's the last play of the game they talk about" syndrome. In the same way that basketball fans curse the player who missed the game-winning shot (even though he made 30 points during the game), an author tends to best remember the last review -- once "turned off" to reviews, he is unlikely to request another.

14 - WHAT CAN GO WRONG WITH A REVIEW?

CODING REVIEWS

Lesson reviews can be dangerously misleading or ambiguous if the reviewer is not experienced or is in some way unqualified. People doing code reviews, for example, tend to get carried away with saving variables, words, units, or whatever. Optimization at the bit level is not generally applicable to PLATO lessons. Clever coding using esoteric commands which the author cannot understand produces no long-term gains. Remember: the goal is to change authors, not lessons.

SUBJECT MATTER REVIEWS

Subject matter reviews are also subject to misdirection. Because many subject matter experts are not trained or experienced as reviewers, they often ignore lesson objectives and student backgrounds. The resulting suggestions, if implemented, may actually degrade the lesson. For example, some subject matter experts ruthlessly root out all half-truths. In the introductory courses of the physical and social sciences many principles and rules are given without stating all the exceptions. Though it is unlikely that the student will ever be confronted with a liquid that won't freeze or a mammal that lays eggs, such things exist. Many subject matter reviewers point out these

exceptions with too great a delight. This forces the author to complicate each rule with qualifications or to list the exceptions. The lesson objectives might have been to teach broad principles and generalities, but the author ends up adding useless information just to satisfy the subject matter expert. The student, in turn, feels that if it's there, he should learn it. One way to discourage the practice of overqualifying each statement is to follow this madness to its logical conclusion; if it's worth mentioning, it's worth testing. If the material meets this criterion it's probably worth keeping -- and it should be in the objectives.

INSTRUCTIONAL DESIGN REVIEWS

Last, but not least, is the instructional reviewer and his set of faults. In addition to just honestly misunderstanding the intent of the lesson, the reviewer may have too high standards considering the author's abilities, time constraints, etc. If the reviewer does not adjust his comments accordingly, he can frustrate the author. A fuller discussion of problems for instructional design reviews is found in chapter II, "How to Review a Lesson."

15 - CAN A CHECKLIST BE USED TO REVIEW LESSONS?

We use a mental "checklist," but it's probably not what you would expect. Our "checklist" is a condensed version of the reviewing categories, not a list of items or specific problems. This may seem strange; many people want specific items listed (e.g., Is the -BACK- key frequently active?). In fact, a number of so-called "reviewing forms" have been devised. We don't feel they are adequate, however.

A problem cannot be ignored merely because it happens infrequently.

Items on a list are typically ambiguous check-off's or ratings. In the -BACK- key example cited above, the reviewer might be expected to check "yes" or "no" or to rate the frequency on a scale ranging from "all the time" to "never." This sort of feedback to the author is unsupported, non-specific, and hence nearly useless. What the author needs to be told is, "Because the directions for the second drill are somewhat complex, the student may wish to press -BACK- before beginning the drill."

To be complete, a list of items against which to check the lesson would have to be very long and most items would be inapplicable to a given lesson. A list of frequently occurring problems is useful for the author checking his own lesson

and for training new reviewers, but it is not sufficient for performing a review. A problem cannot be ignored merely because it happens infrequently. In general, we have found that because of the diversity of lesson types, item checklists cannot provide a complete review. A list of categories which we found useful is located on page 115.

Chapter IV - End-Of-Lesson Reviews

This chapter describes some special techniques used when performing end-of-lesson review. It includes general comments, flow charts, and annotated printouts from reviews we have done.

15 - ADDITIONAL TECHNIQUES

In addition to following the guidelines of chapter II, there are some additional techniques which are especially useful when performing an end-of-lesson review. The rationale for these special techniques is based on (1) the "completed" status of the lesson and (2) the feasibility of including an annotated printout because of a reduced need for immediate (hours or days) feedback.

While writing an end-of-lesson review using a printout, the reviewer would add the following steps to the procedures outlined in section 4. The following steps would be done during the third pass through the lesson.

> Follow the flow of the lesson on the printout as you go through the lesson. Take note of any parts of the lesson that are on the printout but are never executed. Make notes directly on the printout. Specific comments on each part of the lesson should be marked on the printout at the exact location of the code for that part. In this way the author can easily implement those changes he agrees with. In inserting comments on the printout we generally color code the comments with three colors of ink. For example, one might use red for misspellings and punctuation corrections, blue for comments about the wording and for making general suggestions for improvement, and green for comments on code revisions that would be beneficial. The use of colors gives the author or a later revisor an indexing system whereby reference can be made to a specific type of comment. Two cautions: (a) black ink is difficult to

differentiate from the printout ink and (b) a felt tip pen produces so much color that a printout may seem to have "bled to death."

Make notes on problems that seem to recur throughout the lesson. For these criticisms the reviewer should note the line numbers of the printout where they occur so that they may be easily referenced in the general comments section of the review.

Level 4 corrections can be easily made on a printout. The effort needed to point out a misspelling on a printout is minor; the psychological impact to the author is also minor. When reviewing lessons without a printout, it is often not worthwhile to point out spelling and punctuation problems because the author may feel the reviewer is looking too hard for things to criticize.

Though one measure of author quality is the ability to accept constructive criticism rationally, we have never encountered an author who didn't react somewhat defensively to a lesson review. What has been surprising is the intensity of the feelings. As an example of the intensity, one project used to review lessons with three people plus the author present for a final discussion/presentation. The pressure on the lesson's author was so great that the group decided to exclude the author from the proceedings.

A partial solution to the problem of intense author reaction is realized if you, as the reviewer, take a careful, calculated approach to the construction of the review. Looking carefully and diligently for <u>many</u> good things to say about the

lesson is useful both as positive reinforcement and as "soft packing" between "hard words." Remember: things that are done well are not so obvious as things done poorly. The effort that goes into revising a lesson segment four times will not generally be obvious to you. Clever coding may escape you. The author will probably expect the positive comments you make, but will be surprised by the unfavorable remarks. To reinforce the author's sound practice, it's necessary to make more than superficial positive compliments. Justification of your comments provides credence that you are sincere (e.g., "That display certainly clarifies what must be two often confused concepts.").

Tone, of course, is important. Suggestions given as questions ("Would it be better if...?) are easier to accept than orders ("Change this to read..."). In general, allowing the author an excuse rather than forcing him to admit a mistake is a good way to reduce the threatening nature of a review. For example, the reviewer might use phrases like, "It seems like this technique would work here, but..." or "Do you really want the student to...?" None of these suggestions for softening criticism is particularly clever; they're just basic human relations, but they are important. The human, personal touch is also important. If the reviewer and author can't meet face-to-face, empathy can be conveyed by a cover letter or introduction. For this reason several sample letters are included with the sample reviews.

17 - SAMPLE REVIEWS

In the sample reviews found on the following pages, the original review is shown in the standard typeface and explanations and notes about the reviewer's comments are shown in script. These examples are based on reviews we have made for the PLATO authors at Aberdeen Proving Grounds, Maryland. We must hasten to point out that these reviews have been loaded with more criticisms than were actually the case.

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D. L. Bitzer, Director

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Sample
Review I

TO: Ron Richardson
FROM: Mary Graham
RE: Review of lesson "lathe"
DATE: June 27, 197-

Sorry to have taken so long getting this material to you, but I didn't return from the site visit until the middle of last week.

I'm afraid I have quite a lot to say about this lesson. So I thought I'd warn you in advance not to worry too much about it. The main problems in the lesson are about the same as those made by most new authors -- and old authors, for that matter.

I hope my notes are somewhat helpful. Please let me know if you disagree with or can't follow any of these comments. We can talk on-line if you'd like.

Sample
Review I

General Comments*

My comments are going to fall generally into three categories:

1. An attempt to summarize my impression of the content of this lesson
2. An attempt to outline the precise skills that are relevant to this content
3. A review of the actual implementation/presentation of the lesson

Specific comments about the lesson appear right on the printout of the lesson.

Part I

In this section I am briefly summarizing the main teaching point of lesson "lathe." The outline is incomplete, but I think it includes most of the important information presented. A checkmark next to a term or characteristic listed means that you have included a question on that point.

I. Introduction

tool bit	A lathe cutting tool
	A wedge forced into the material -- Results in a "rupture" or "plastic flow" of the material

*This section gives the author an overview of the comments the reviewer made. It is important that the review be well-organized, concise, and graphically pleasant if the reviewer is to be credible to the author as an expert. Hypocrisy comes too easily.

Sample
Review I

II. Tool Bits - Types of Material

tool bits	Most are made of steel
carbon steel tool bit	√Made of high carbon steel
	Economical
	√Loses temper at relatively low heats
high speed steel	Alloyed...
	Remains hard even at very high temperatures
	√Most commonly used for general machine work
	Like carbon steel tool bits, it's forged
stellite	Made of chromium, cobalt and tungsten
	Is cast, not forged
	√Used mainly for abrasive materials like cast iron or bronze

*(For brevity, the rest of the outline is deleted.)**

In addition to the material listed above, several undefined terms appear in the lesson. I assume the student already knows enough about them to proceed with the new material.

Again, the list is incomplete but it may give you an idea of the

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**The outline was made by the reviewer as part of her analysis. It is presented here to show the author how the lesson was perceived. One problem is raised subtly at this point -- a lack of check marks beside most topics points out something the author may have been unaware of: a great deal of information is presented but only a small bit of it is tested.*

type of thing I mean.*

The student is expected:

1. To recognize the different parts of a lathe cutting tool --

   a. the holder
   b. the bit
   c. the cutting edge
   d. the tool

2. To recognize names for different parts of the work piece --

   a. the shoulder
   b. the end
   c. the face
   d. the external part
   e. the internal part
   f. the axis

3. To recognize the effects on a work piece of the following operations --

   a. turning
   b. facing
   c. boring
   d. knurling
   e. cutting threads
   f. making grooves

As I see it, these are the skills relevant to the content of your lesson "lathe."

1. Given characteristic, provide or recognize term
2. Given term, provide or recognize characteristic
3. Given picture, provide or recognize name of item
4. Given name of item, select picture of it
5. Discriminate among terms/pictures presented by matching them -- called multiple discrimination

---

*The reviewer doesn't know and can't easily determine what terms and concepts the student should be familiar with when he takes the lesson. She lists the assumptions in a non-reproachful way. However, by seeing this list, the author is reminded explicitly of several decisions he has made implicitly.

Sample
Review I

The following matrix shows the relationship among these skills and the main subdivisions of the lesson. Checkmarks indicate some questions in the area.*

	1	2	3	4	5
Tool Bits -- Types of Material	✓	✓			
Tool Bits Tasks			✓	✓	
Tool Bit Holders			✓	✓	

As you can see, the lesson doesn't give the student any practice at all in some of these skills. And there is not much chance to practice some of those checked.**

One thing you can do now is go back to your (or my) content outline of the lesson and decide what you really want the student to know. Then dump out whatever is left over.***

If you want the student to know the important characteristics of tool bits and holders, you must give him an opportunity to respond to them. If not, you can eliminate the extra details and save him time.

Next, if you look at the skills I've listed, you'll see that the most

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*The reviewer states her assumptions, then delivers the facts. By now, the author should be picking up the pattern and be somewhat ready for what is to come.

**Finally, here comes the message. The reviewer has "telegraphed her punches" so that the author shouldn't be surprised. The evidence is all there.

***Here is the solution for the author. When the reviewer does such a thorough job demonstrating a problem, it's only fair to show the author a way out.

complex one (5) is not dealt with by the lesson. It is important to include questions that help the student tie together all the individual facts you've given him. In that way he will get to understand the relationship among them.

Finally, asking one question per fact is just not enough. Even if the point is so simple that one question should indicate understanding, it is important to "seed in" questions on the same point at intervals throughout the lesson in order to reinforce the student's grasp of the information.

A useful way to accomplish these last two at the same time is to review items simultaneously -- that way you allow the student to tie them together and get more practice all in one shot.

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D. L. Bitzer, Director

Sample
Review II

Dear Fred,

My comments are divided into three major sections similar to the structure of my review of "drills":*

1. General comments
2. Flow charts and related comments
3. Specific comments as written directly on a printout of "keys" (Please note that these are color-coded as per the key on the printout).

This review is obviously for your benefit and therefore you should be the person to decide on which parts of my comments are applicable, warranting changes to the lesson, and which parts are not.** I only hope that you will "review" -- so that I will know how to direct my future reviews more precisely to your needs.*** After you have had a chance to analyze these notes, I will check with you on-line and arrange for some time when we may get together on the telephone to work out any specific ideas you may have.

Thank you very much for your time and patience. If I or my organization can give you any further assistance in either programming or educational development, please don't hesitate to contact me.

Sincerely,

John Kiley

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*Just as the reviewer feels the student needs a map of the lesson (a comment the reviewer makes later in this review), he feels the author needs a map of the review.

**This sort of sentence is included so that the author knows that the reviewer is not trying to grab authority that isn't his.

***Feedback to reviewer is important. A strong request for this feedback also shows genuine concern for the author's feelings and reactions.

Sample
Review II

I. General Comments

A. Organization

In flow chart II, I have outlined an alternate way to deliver the material in "keys." The major changes from the present version are described below. Also included is the reasoning behind my suggestions.

1. Pretest

Your pretest is an excellent idea. However, shouldn't a student who takes the test without studying the lesson be required to pass the same final exam as his counterpart who went through the entire lesson?* That way you are assured that all the students who complete "keys" will have the same minimum level of mastery.

2. "End-of-Lesson Test"

I think it might be very helpful if the questions in each section contained only drill questions and if the lesson had one final test to evaluate the student's knowledge. That test could be organized so that if the students received more than a pre-specified number of wrong answers in a specific area, he would be sent back to that point in the lesson where the information he lacked was first covered. Then,

---

*The author had a linear lesson which students could complete for full credit. Alternatively, they could take a pretest and, if successful, bypass all instruction. In the event that they took the instructional path through the lesson, there was not an end-of-lesson test.

after completing that section, he could be returned to the area of the test in which he had been working. That is represented in flow chart II by the red lines going from the block "End-of-Lesson Test" to each specific subject area.

3. Order of Representation

On flow chart II you can see that I have placed the "General Data" first and then followed that with specific data on each of the keys. Because the "General Data" applies to every key covered in the lesson, I think it would be helpful if the students were introduced to it first, so that they can apply it to each different key as it is encountered in the lesson.

4. "Help" Sequences

a. I have included in flow chart II five help sequences, one for each major key and one for the general data section. They would work similar to those you designed for "drills".* In each subject area the student's error count would be initialized to zero. During the drill, if that count went over a preset amount (in flow chart II, I suggested "error=3" and have depicted that branching with a red line), he would automatically be put into a help-type sequence where he would be given remedial instruction

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*The reviewer effectively is saying, "I know you are smart enough to think of this, because you've done it before. Furthermore, it was a good idea."

and then returned (re-setting his error count to zero) to the place he had been in the lesson. The help sequence would also be available via the -HELP- key. That way the student would never get "hung up" at an arrow.*

On the other hand, you don't want to bore the good student with too much drill.** To prevent this, you could have PLATO send the student onward to the next topic (this is shown on the flow chart as a green path) after some preset number of consecutive correst responses. (For example, I chose "correct=3" in the flow chart). This will keep the student from becoming bored with material he already understands and also allow the good student to complete the lesson in the shortest possible time.***

Note: A way to write the code to do this branching was suggested by John Smith as follows:

(Deleted for brevity)

b. The other form of help sequence seen on flow chart II is one that the student can initiate at each "summary" block. Those paths are depicted with lavender dotted lines coming from each of the two summary sections. After

---

*The reviewer is indirectly saying that a student could get trapped by a question he can't answer. However, instead of dwelling on the problem, he points out a possible solution.

**In these sentences, the reviewer is handing out some instructional design philosophy -- and a way to implement it.

***A lesson characteristic is linked to one of the project's overall goals -- time savings.

studying the information in the summaries, the student could elect to see any part of the lesson material for which he feels the need for further review. That sort of branching could be programmed without requiring any new text insertion in any of the major blocks.

5. "Full Summary" Block

I suggested adding this block because I thought the students would be helped by seeing all the data together in one place and because it would allow them the opportunity to branch back into any part of the lesson that they may want to review before taking the final test (see part 4 above). One way this summary may be set up would be in chart form. For instance:*

Key	Physical Characteristics	Use (Pro & Con)	Tools to cut Keyway	Techniques to cut Keyway
square				
round				
...				

B. "Lesson Objective"

The present lesson objectives (lines 594-609 on the printout) seem like they might be redundant.** Most of the information

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*Specific details of how suggestions might be implemented seem generally welcome. Though the exact implementation may not follow the reviewer's suggestion, merely suggesting a "chart form summary" supplies too little detail.

**References to printout are done where possible.

in the second paragraph is contained (and is well-stated) in the first. It seems like you could easily condense those two paragraphs into one concise statement.

C. "Introduction"

The "Introduction" section is one of the most important sections in the lesson, I see it serving three main functions:

1. Carefully indoctrinating the student into the subject material of the lesson
2. Supplying the student with a "road map" of that lesson which is to follow. In this way, the student can get a feeling for where he is in the lesson and what directions he could possibly take
3. Telling the student about how the "help" sequences work and how he himself can find the information in the lesson -- without the aid of a proctor

Your introduction does an excellent job on "1" and "3" but is rather brief on "2."* Would a table of contents help?

D. Titles on Frames

1. When you introduce a new topic on a new frame it is usually a good idea to place at the top of that frame an appropriate title (in relatively large letters -- maybe size 2). That way the student sees at a glance just what topic the frame

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*The criticism here is embedded in praise. The compliments on what was done well will hopefully encourage the author to continue to supply a carefully constructed introduction.

will cover and realizes that the past topic has been completed. This is very similar to chapter and section headings in most books, and serves a very necessary purpose.

2. In reference to your lesson as written, I have put remarks on your printout suggesting a title at the introduction of the following units:*

unit name	line location on printout
squ	246
squ6	396
squ7	435
squ9	485
squ10	518
rd1	666
rdsum	715
wood	745
line	853

II. Flow Charts I and II - Related Comments

On chart I, I have tried to depict the structure of "keys" as I see it. It seems very linear (i.e., one single path with little branching allowed) and gives the student only a few chances for review. The green lines indicate normal progress through the lesson, while the red lines indicate a PLATO-initiated branch for remedial instruction.

On chart II, I have tried to depict a restructuring of "keys"

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*There is no reason for the author to duplicate the work of the reviewer in locating the places that need titles.

that I think would adapt to a broader range of students. The key features of this are explained in part A of the General Comments section of this report. Again, the normal student progression is shown by the green line. PLATO-forced branching (including remedial help) is shown in red. Student-initiated review sequences are shown in lavender.*

*Of course, none of these colors can be shown in the following flow charts; instead lines are labeled.

CHART I

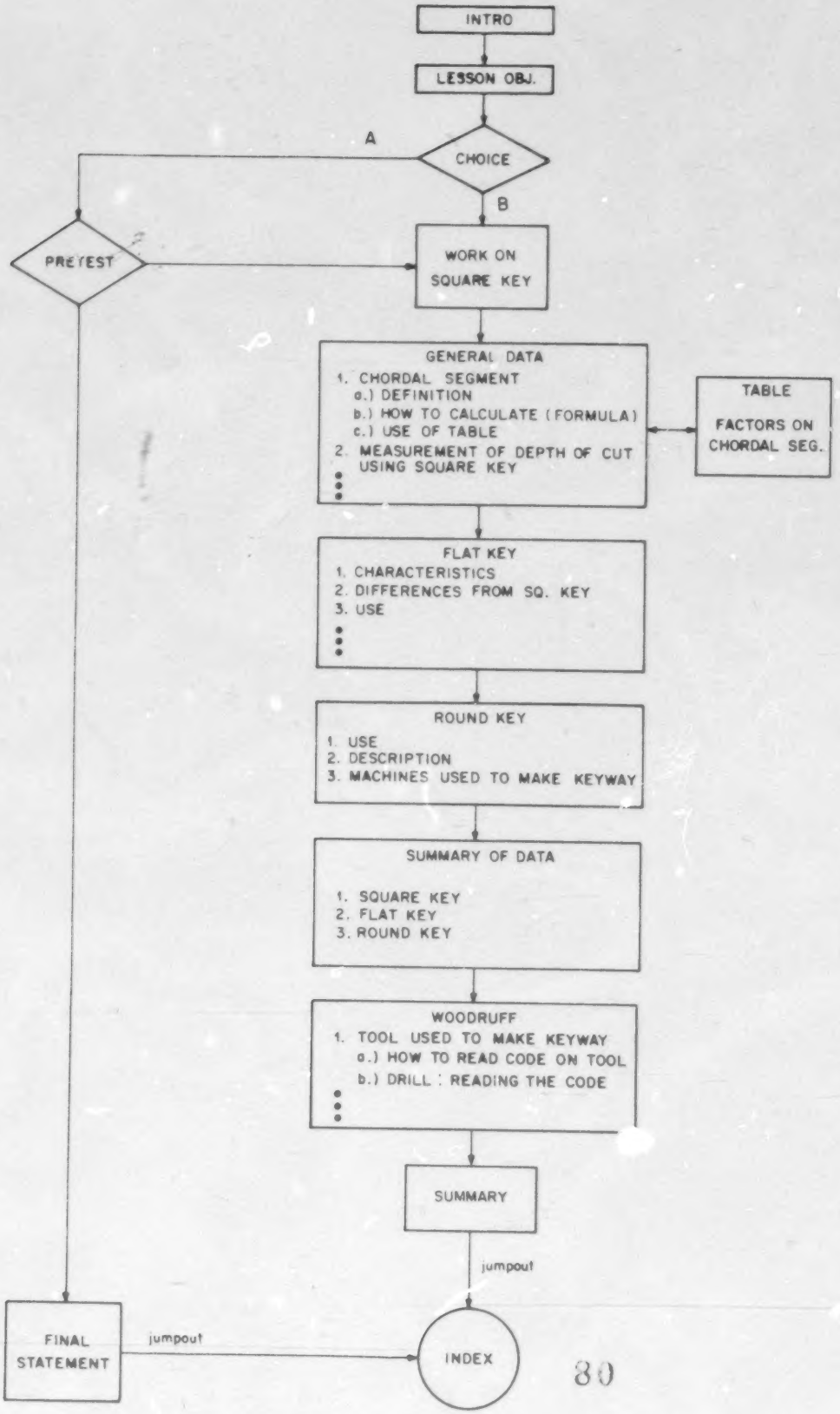
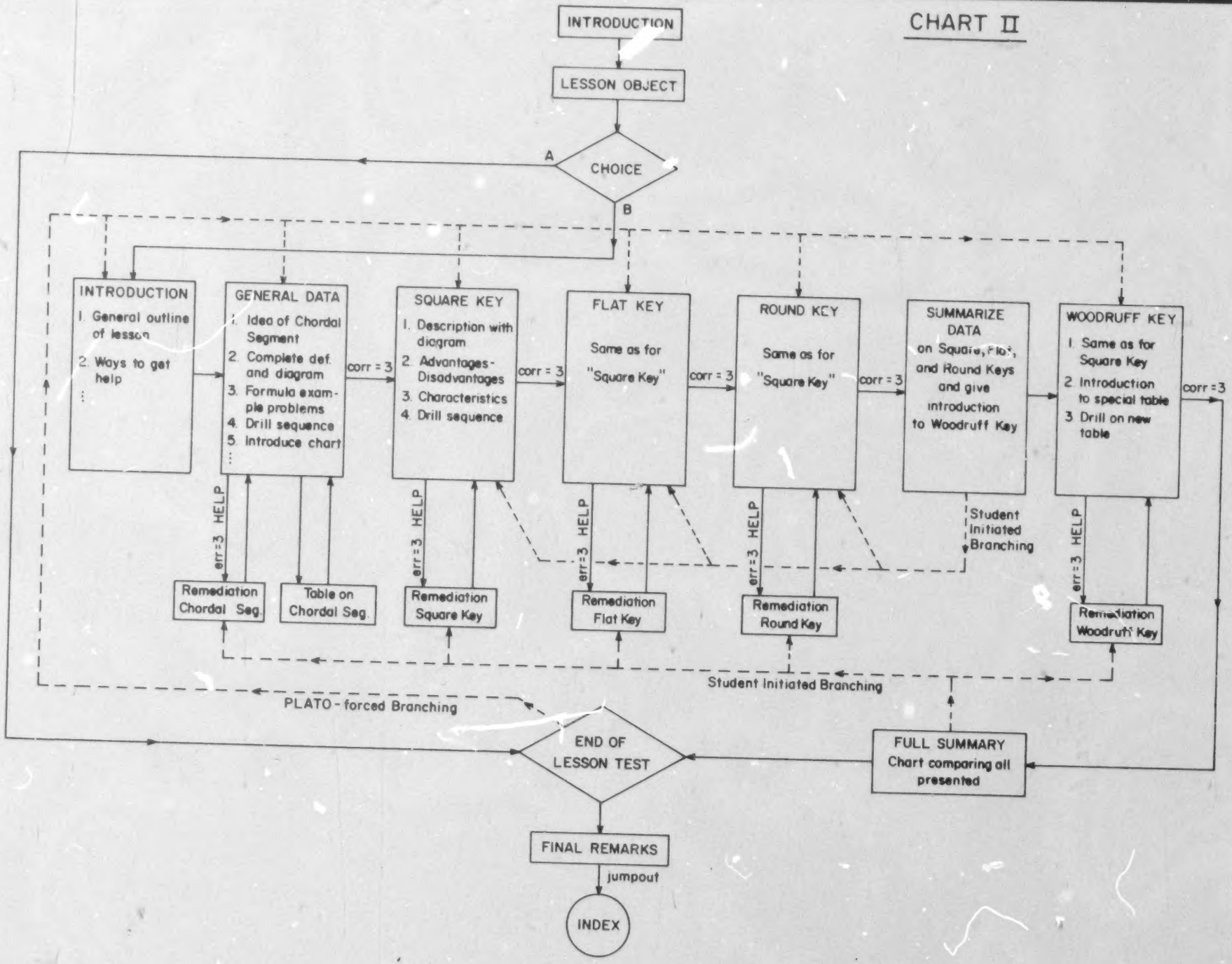

INTRO
LESSON OBJ.
A
CHOICE
B
PRETEST
WORK ON SQUARE KEY
GENERAL DATA
1. CHORDAL SEGMENT
a.) DEFINITION
b.) HOW TO CALCULATE (FORMULA)
c.) USE OF TABLE
2. MEASUREMENT OF DEPTH OF CUT USING SQUARE KEY
TABLE
FACTORS ON CHORDAL SEG.
FLAT KEY
1. CHARACTERISTICS
2. DIFFERENCES FROM SQ. KEY
3. USE
ROUND KEY
1. USE
2. DESCRIPTION
3. MACHINES USED TO MAKE KEYWAY
SUMMARY OF DATA
1. SQUARE KEY
2. FLAT KEY
3. ROUND KEY
WOODRUFF
1. TOOL USED TO MAKE KEYWAY
a.) HOW TO READ CODE ON TOOL
b.) DRILL : READING THE CODE
SUMMARY
jumpout
FINAL STATEMENT
jumpout
INDEX

CHART II


INTRODUCTION
LESSON OBJECT
A
CHOICE
B
INTRODUCTION
1. General outline of lesson
2. Ways to get help
GENERAL DATA
1. Idea of Chordal Segment
2. Complete def. and diagram
3. Formula example problems
4. Drill sequence
5. Introduce chart
SQUARE KEY
1. Description with diagram
2. Advantages-Disadvantages
3. Characteristics
4. Drill sequence
FLAT KEY
Same as for "Square Key"
ROUND KEY
Same as for "Square Key"
SUMMARIZE DATA
on Square, Flat, and Round Keys and give introduction to Woodruff Key
WOODRUFF KEY
1. Same as for Square Key
2. Introduction to special table
3. Drill on new table
corr = 3
err=3 HELP
Remediation Chordal Seg.
Table on Chordal Seg.
Remediation Square Key
Remediation Flat Key
Remediation Round Key
Remediation Woodruff Key
Student Initiated Branching
PLATO - forced Branching
END OF LESSON TEST
FULL SUMMARY
Chart comparing all presented
FINAL REMARKS
jumpout
INDEX

```
149  unit     q4
150  term     q4
151  write    (at,1310)What is the diameter of a #807 Woodruff
152           keyslot cutter?
153  arrow    1610
154  spell    okextra,bumpshift
155  put      seveneights=seven eights
156  bump      ,-
157  wrong
158  judge    ignore
159  answ     .875,.0020
160  answer   (seven eights,7/8)<",inches>
161  *nextnow finish
162  no
163  nextnow wood

164  unit     q5
165  term     q5
166  write    (at,1510)Look at your handout on the WOODRUFF keyslot
167           tables, and determine what distance a #404 woodruff
168           key should protrude above the shaft?
169  arrow    2010
170  wrong
171  judge    ignore
172  answer   .0625
173  write    Real fine, you seem to know you stuff about keys
174           and keyways.
175  nextnow finish
176  no
177  write    What you are looking for is the  C  reading on the
178           chart.
```

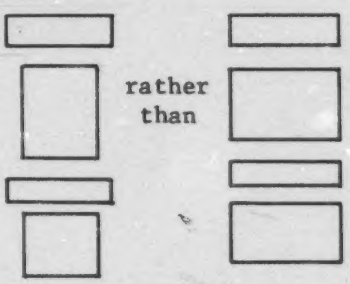
Note quotes (") are considered punctuation by PLATO and hence are ignored. You probably want to accept "eighths" too. Also note that an asterisk (*) should be placed between two word synonyms i.e., seven*eighths.

part=1, block=d

space lef

```
179  unit     obj
180  term     obj
181  at       508
182  size     3
183  write    LESSON OBJECTIVES
184  size     0
185  at       408
186  write     You must be able to properly indentify the
187           commonly used keys and keyways, and calculate the
188           dimensions for machining the keyways to the correct
189           dimensions to within ±.002, using the procedures as
190           stated in the appropriate lesson materials.
191  do       box
192  pause
193  at       1508
194  write    Given certain specific sizes, types of keys, and
195           the appropriate charts or tables, you must
196           be able to accurately calculate the dimensions for
197           machining the keyway to the prescribed dimensions.
198  pause
199  at       2308
```

Consider staggering the paragraphs for eye appeal. For example:



```
412
413          H= Chordal segment height
414          W= Key width
415          D= Shaft diameter
416  join    chord
-------------------------------------------------------------- part=1, block=g ----------------
                                                                              space left
417  at      386,343
418  write   H
419  do      box
420  pause
421  at      1700
422  write   An example for a 3/8 inch keyway in a 1-1/2 inch shaft
423
424          W²/D = 3/8×3/8 / 4×1-1/2 = .1406/6 = .0234
425
426          This would be the amount we would have to add
427          to half the thickness of the key to get the
428          FULL DEPTH OF CUT.
429  draw    72,216;96,216;skip;118,216;176,216;skip;208,216;248,216
430  at      2500
431  write   What would be our total depth of cut for the
432          3/8" keyway that is used in this example?
433
434                              (3/8"=.375)
435  arrow   2900
436  ansv    .211,.0020
437  at      3000
438  write   Real fine.  That measurement would be the amount that
439          we would set on our machine for the FULL depth of cut.
440  next    squ7
441  wrong   211                                          -wrongv  211,2- ??
442  at      3000
443  write   Did you forget the DECIMAL point?  That little dot      Good!
444          is very important.
445  no
446  at      3000
447  write   Add half the key thickness .1875" to the chordal
448          segment .0234" that is shown above.

449  unit    squ7
450  term    squ7
451  at      400
452  write   Once the full depth of cut has been made on the
453          machine, we must take into consideration exactly
454          how we are going to measure the depth of the
455          keyway.
456          There are two basic ways of measuring the depth of       The drawing that accom-
457          the keyway and each method will give a different         panies this explanation
458          reading.  If we measure from the top of the of the       is very lucid -- nice
459          shaft to the bottom of the keyway, we are measuring      work!
460          our full depth cut. (The depth of the keyway plus
461          the chordal segment)
462  do      box
463  pause
```

Very useful to provide definition of symbols for your drawing.

Having a unit go across a block boundary can be confusing. Be careful!

Use SUB,SUP to get $\frac{3}{8} \times \frac{3}{8}$. The "-" looks too much like "minus." The technique you used in line 529 is nice.

```
464  at        1508
465  write     By placing the depth micrometer across the top of
466            the keyway and measuring to the bottom, we are only
467            measuring the depth of the keyway.
468
469            If we are measuring from the top of the shaft to the
470            bottom of the keyway, what should be our correct
471            measurement if we are to the FULL DEPTH machining
472            a 1/4" keyway on a 1" shaft?
473                                    segment
474            The formula for chordal segeml is H=W²/4D  =.0156"

475  arrow     2509
476  ansv      .141,.0020
477  at        2708
478  write     By adding 1/2 the width of the key (.125) to the
479            chordal segment (.0156) you get a total depth
480            of cut of-.141".
481  nextnow   squ8
482  wrong     141
483  write     Did you forget the decimal point?
484  no
485  at        2708
486  write     To calcuate the TOTAL DEPTH of CUT, Take HALF the
487            the thickness of the key and add that amount to
488            the CHORDAL SEGMENT. .250÷2=.125  .125+ .8156=?
489            find the total depth of cut.
```

The student never practices using H=W²/4D. He should be told he will not need to learn the formula or calculate using it, only that he will need to know how to use the results of applying the formula.

Could you put a diagram here if not answered correctly?

part=1, block=h

space le

```
490  unit      squ8
491  term      squ8
492  join      table
493  at        2008
494  write     As you can see the chordal segment must be properly
495            calculated in order to achieve the necessary accuracy.
496            The chart above has been prepared for you, to eliminate
497            having to calculate the chordal segment.
498  do        box
499  pause
500  at        2608
501  write     The left hand column indicates the diameter of the
502            shaft. The other columns indicates the width of
503            the keyway to be used.
504            You may refer to this chart when needed by pressing
505            the -HELP- key on the right side of your keyset.

506  unit      squ9
507  term      squ9
508  help      table
509  at        409
510  write     There are other ways to measure the depth of our
511            keyway, than using a depth micrometer and measuring
512            from the shoulder to the bottom of the key.
513  join      mike
```

Does the student need to practice reading the table?

You could put -help table- in the imain unit at this point. There is no need to change your lesson, however, just remember it for the next time.

```
514  join    smike
515  do      box
516  pause
517  write   (at,2408)Whenever we have a measuring device that will fit
518          into the keyway, such as an outside micrometer or
519          a vernier calipers, we can  measure from the
520          bottom of the keyway to the bottom of the shaft.
521          By knowing what this measurement should be, you
522          can accurately measure the depth of keyway.

523  unit    squ9a
524  term    squ9a
525  help    table
526  base
527  at      210
528  write   Let's assume that you are to cut a keyway
529          for a 1/4" square key in a 1 1/8" (1.125) shaft.
530          what would be the reading from the bottom
531          of the key to the bottom of the shaft if
532          if you are to the correct depth?
533
534          REMEMBER the CHORDAL SEGMENT!!
535          If you need to use the chordal segment chart
536          you may do so by pressing the  -HELP- key.
537  join    mike
538  join    smike
539  vector  264,255;264,282
540  vector  264,245;264,209
541  write   (at,260,242)X
542  arrow   2210
543  answ    .986,.0020
544  at      2403
545  write   Real good.  By subtracting  the depth of the key (.125)
546          and the chordal segment (.0139) from the diameter
547          of the shaft we obtain the correct reading (.986)
548          proper depth.
549  next    v20=1,test,x
550  wrong   986
551  at      2408
552  write   Did you forget the decimal point?
553  no
554  write   You must first calculate the TOTAL DEPTH of cut,
555          by taking HALF the key thickness (.250-2= .125).
556          .125 plus the chordal segment .0139 = .1389 or .139"
557          Then subtract .139 (whole depth) from the shaft
558          diameter 1.125   1.125 - .139 = ?
```

Good use of SUB/SUP

Yes, it's good to remind students when -HELP- is active.

You can use a -wrongv 986,2- to put the same tolerance on your check for decimal errors.

part=1, block=1 ---------- space left

```
559  unit    flat
560  term    flat
561  at      208
562  write   Another similar type of common key is the FLAT KEY. This key
563          is similar to the SQUARE KEY but has some different
564          characteristics, one is that the key is rectangular
```

```
671  calc    v100=v100+1
672  at      1910
673  write   Real good.  Now that you have accurately calculated
674          the correct depth of cut you should also calculate
675          the correct micrometer reading from the bottom of
676          the key to the bottom of the shaft.
677  arrow   2410
678  ansv    v89,.0020
679  at      2510
680  write   You are doing great!!
681  no
682  write   You can get the correct answer by subtracting
683          the total depth of cut from the shaft diameter
684          which is 1 inch.

685  unit    rd1
686  term    rd1
687  at      800
688  write   We have discussed two of the most common types of
689          keys that you are apt to encounter as a machinist.
690          Another common type is the round end key.  This
691          key is also like a square key, in that the width
692          and the thickness are the same.
693  do      box
694  pause
695  at      1400
696  write   One or both ends may be rounded, depending on the
697          intended use of the key.  The radius on the end of the
698          key is equal to one half the width of the key.
699          All the dimensions are exactly the same as for square
700          key when you are calculating the total depth of cut.
701          The length of the key should be equal to a minimum
702          of 1-1/2 times the width of the key.
703  do      box
704  pause
705  at      2200
706  write   Round end keys are used primarly when the mating
707          parts are located away from the end of the shaft.

708  unit    rd2
709  term    rd2
710  at      4800
711  write   To produce a round end keyway in the middle of a
712          shaft, what type of cutter should be used?
713  arrow   1100
714  specs   bumpshift,noorder,okextra,okspell
715  answer  (end mill,endmill)(two lipped)
--------------------------------------------------------------- part=1, block=k ----------
716  help    Table
717  at      300
718  write   Exactly!  An end mill is the most appropriate cutter
719          to use.  The size end mill to use must be the same
720          as the width of the key.  When cutting the keyway
721          we should allow approximately .005" to .006" more
```

Should this unit begin a new "area"?

See SUB/SUP comment on line 424.

See notes on line 160 regarding a problem with answer judging.

space le

Chapter V - In-Progress Reviews

This chapter describes the philosophy and technique of in-progress review, discussing some of the inherent problems of end-of-lesson reviewing, some past experiments with review techniques, and our current review methods.

10 - THE SOCIOLOGY OF REVIEWING

A lesson review can be one of the most valuable tools an author has for writing effective lessons. Experience, however, has taught us not only the usefulness but the precariousness of reviewing. Often the value of a review is clouded by factors which are interwoven with but irrelevant to the review itself. Authors are sometimes prey to pitfalls inherent in the process rather than the product.

In the past, we've had scant success at getting authors to actually use reviews to improve their lessons. While authors were always perfunctorily complimentary, they seemed more inclined to file reviews away, giving little indication of what they disagreed with or objected to about reviews. Assuming (perhaps naïvely) that review quality was not the question, we concluded that other more subjective or ambiguous elements were involved. The fact that authors were so reluctant to talk about reviews seemed to support the assumption that feelings rather than issues were at stake. Thus we turned our attention from the review itself to review techniques and from the impact reviews had on lessons to the effect they had on authors.

This, then, describes our experiments in exorcising both the technical and psychological demons in reviewing.

PSYCHOLOGICAL TRAPS

An author makes a considerable psychological and emotional investment in his lesson. Just as artists sometimes find it difficult to separate themselves from their work, authors often find it difficult to separate themselves from their lessons. To criticize the lesson is to criticize the author. Consequently, the reviewer is often regarded more as an adversary than an ally, particularily when the reviewer lacks instructional experience. If the two have never met, an author's image of a reviewer is frequently fashioned by factors that have less to do with the reviewer than with the author's own frustrations.

The reviewer is often regarded more as an adversary than an ally.

Apart from the question of author/reviewer rapport, there is the problem of time. A thorough end-of-lesson review typically requires a number of weeks to prepare. During that time the author has usually begun work on a new lesson. Since enthusiasm for the old lesson is usually replaced by the preoccupation and momentum of work on the new lesson, revision is relegated to a limbo status to be carried out "as soon as this new lesson is finished." As the old lesson gets "colder," revision seems less and less important until it's easiest to regard a lesson as "finished" simply because coding is complete.

The most detrimental drawback of the review process, however, is the problem of the part versus the whole. Any task is more

burdensome handled collectively rather than selectively. The impact of a review exemplifies this pitfall. Singly, each criticism or suggestion the reviewer makes may seem reasonable and helpful to the author. Collectively, however, the suggested changes appear so massive that lesson revision can seem overwhelming. The author is likely to regard the reviewer as overly critical and simply shelve the review entirely.

TECHNICAL TRAPS

Two technical problems center around one outstanding dilemma -- time. At the sites we work with, authors are under considerable pressure to meet semester deadlines, project deadlines, etc. Thus, they sometimes feel an understandable reluctance to "waste time" revising what is considered to be a completed lesson.

The reviewer might also find himself suggesting major instructional strategy changes which essentially amount to a complete overhaul. The need for such substantial revision, apart from being time consuming, might have been averted had the author and reviewer been able to consult in the planning stages, using the review as a proposal rather than a post mortem.

The problem of author/reviewer consultation is also a technical stumbling block. A review, almost by definition, is a rather lengthy soliloquy, a one-sided excursion through the lesson's strengths and shortcomings. This monologue quality, coupled with the other inhibitive elements of the review process,

does little to enhance any real exchange of ideas between author and reviewer.

Realizing the obstacles, our task became a simple matter of developing a review technique that removed the stigma of reviewer as "critic," reduced the author's emotional involvement, capitalized on lesson momentum, minimized both the impact of and need for massive revision, made efficient use of author time, and established a free flow of ideas between author and reviewer!

Our initial review experiments mainly dabbled with variations on the end-of-lesson theme. Though authors were as complimentary as ever, there was still little evidence that they actually used the review for lesson revision. A cleaner break with our old techniques needed to be made.

IN-PROGRESS REVIEWING

An in-progress review, like an end-of-lesson review, is a set of comments used to improve the instructional effectiveness of a lesson. During in-progress reviewing, however, the reviewer examines the lesson in bits and pieces at various stages of development rather than as a whole after coding is complete. To maintain continuity and an overall perspective, in-progress reviewing, rather than being a fragmentary approach, is a cumulative procedure in which the reviewer re-examines "old" sections in addition to successive "new" segments. This patchwork process seems (in our experience thus far) to minimize a number of previous problems. Dealing with the lesson in pieces as it's being written:

- reduces author defensiveness by examining the lesson before the author's subjective involvement becomes too strong.
- capitalizes on lesson momentum by giving the author immediate feedback while the lesson is still "current."
- enables the author to make any necessary modifications or corrections before they become habitual.

PAST

Though the review process had been radically transformed, we still believed in the importance of providing the author with a hardcopy critique of the lesson. To maintain the fast "turn around," immediate feedback policy we were trying to establish, we put generalized comments in a note file on-line. Then we mailed both additional specific suggestions and an edited printout to the author. The only problem was that since the author was continually revising and expanding his lesson, the written comments were outdated by the time they reached him.

PRESENT

With the advent of the Varian copier we are now able to provide the author with immediate on-line commentary which he can copy at his own site. Currently, we put most written reviews in a review lesson in which the author is also encouraged to make replies or rebuttals, ask questions, etc. There are, of course, pros and cons to be weighed in using such a "public" means of criticizing lessons. Since authors at some sites have had little

CAI experience, this method allows them to learn from each other's successes and "failures." However, depending on the quality of the lesson and the nature of the review, some authors feel justifiable pride over a "good" review while others feel equally justifiable embarrassment over a "bad" review. Too often the review file has (among authors) been a source of competition rather than learning. PLATO's monitor mode option now affords the reviewer and author the "privacy" many authors feel more comfortable with. Using this technique, the author monitors the reviewer as the two go through the lesson together frame by frame. Apart from "protecting" squeamish authors, monitoring enables the reviewer and author to have a free-flowing, spontaneous exchange of ideas, viewpoints, etc.

When a particular change is difficult to explain and the author needs some clarification, or when the suggested alteration is time consuming (or beyond the author's coding ability), the reviewer copies part or all of the lesson into a workspace. He can then revise this replica of the lesson without tampering with the original. From the reviewer's standpoint, it's more persuasive to show than to tell about how a particular change should look and the author, of course, has the option of copying the changes into his lesson.

FORMAT

In-progress reviews cover the same areas and levels as end-of-lesson reviews. Whereas end-of-lesson reviews are generally more lesson oriented, in-progress reviews are more author oriented.

The reviewer tries to be sensitive to the effect his remarks will have on the author and to temper the tone of the review accordingly. Since our working situation is such that we deal repeatedly with the some authors, our reviews are often directed more at long-range philosophical changes than at specific lesson changes.

A written in-progress review usually opens with general comments about the reviewer's overall impressions. The reviewer tries to point out those parts he particularly likes, any techniques that seem especially effective, etc.

The body of the review is a unit-specific assessment on a number of different levels (see section 3) some of which are:

A. Details
   1. spelling
   2. punctuation
   3. grammatical errors

B. Display techniques
   1. highlighting
      a. underlining
      b. sizing
      c. pausing
   2. characters
   3. positioning
   4. amount of text

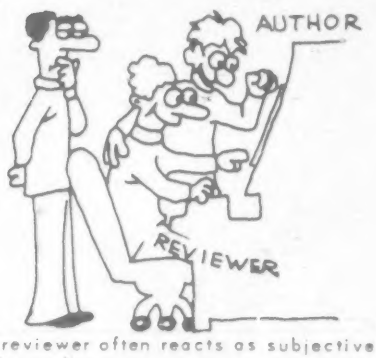
C. Content
   1. lesson flow
   2. branching
   3. contradictions
   4. conformity between content and objectives
   5. style

D. Teaching strategy
   1. interaction
   2. graphics
   3. simulations
   4. questioning techniques

IN-PROGRESS VERSUS END-OF-LESSON REVIEWING

In summarizing which type of review should be used at what times, a number of points should be reiterated.

In-progress reviewing is an excellent technique for giving immediate feedback. Thanks to the system "talk" option and monitor mode, the reviewer can fit the review to individual author needs, and reviewer and author are able to work in close rapport. In addition, the reviewer figures more prominently in lesson development and his role is broadened to include reviews of educational objectives, criterion tests, lesson design, etc.



The reviewer often reacts as subjectively as the author.

There are two main drawbacks to in-progress reviews, however. First, though reviewing lessons in sections reduces author defensiveness and maintains lesson "momentum," it's difficult for the reviewer to assess the flow of the lesson or establish much of a total view. Second, after reviewing the same lesson over a period of weeks or months, the reviewer can tend to lose his objectivity and independence, often reacting as subjectively toward the lesson as the author. For these reasons, after a reviewer and author have worked together on a lesson and each consider it "finished," we have a second reviewer do a final, objective end-of-lesson review.

19 - SAMPLE REVIEWS

The following section contains review samples and "before and after" examples of some sorts of changes one author made in his lesson after a review.

Sample III is a review of two sets of lesson objectives. The objectives to be reviewed (with opening author comments) are followed by the reviewer's suggestions.

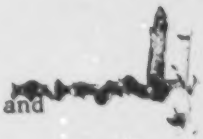
Sample IV is a "follow-up" review of a lesson which had been reviewed numerous times already at various stages of development. The numbered comments all reference specific units.

Sample V includes a "first" review of a lesson with examples of some of the changes the author made as a result of the review.

Sample
Review III

"Here are the lesson objectives for the topics listed. Any and all comments are welcome. But, I don't have a flak jacket on."

RESP MUSCLE PARALYSIS



1. Student must identify two types of neuromuscular blocking agents and must define their mechanism of action.
2. When given the name of a neuromuscular blocking agent, student must determine which type of blocking the drug represents.
3. Student must define structure and function of a neuromuscular junction.
4. Student must list three measures available to prevent botulism poisoning.

Objective #1 is very good. Does the word identify mean that the student will state or pick out the two types? In other words, are you asking the student to supply or recognize information?

2. List and define are excellent behaviors to have specified in questions 3 and 4...how, specifically, are you going to test this sort of behavior? Are you planning to use question forms other than multiple-choice?

NARCOTICS

1. Student must list three characteristics that indicate narcotic analgesic intoxication.
2. Given the definition inflammation of a vein, the student must be able to determine the condition described.
3. Student must list trade name and generic name for one out of three narcotic antagonists.

Sample
Review III

---

1. *Last comment for Resp Muscle Paralysis applies to this section, too.*

2. *Objective 3 is very good, very precise.*

4. Student must pick narcotic antagonist of choice from a list of four drugs.

5. Given four statements about narcon, student must pick incorrect statement.

---

3. *My lack of content knowledge is showing again, but #4 seems to be missing something...do you mean something like, "Given a number of narcotics, the student must choose the antagonist of choice for each from a list of four drugs?"*

4. *Objective 5 is precisely stated, but conveys very little about what exactly you want the student to know about narcon. For instance, are you talking about chemical composition, effects produced, antagonist, etc.?*

Since so many objectives require the student to supply information (define, identify) rather than simply recognize information, I'll be very interested in seeing the criterion test to see how you test this sort of behavior.

That's all for now,

Sascha

Sample
Review IV

"What more can we say? This series of lessons has matured into a truly impressive example of how to be both interesting (and often entertaining) and informative at the same time. Though it takes quite awhile to work through the entire group of lessons, I don't think you'll have any trouble holding the student's interest.

A number of things stand out in our minds, and deserve recognition...the most striking aspect of the series is that you use a number of different strategies, questioning techniques, display techniques, etc. You also have the student interacting in a number of different roles (sometimes as a student, sometimes as a P.A., etc.) -- these are two factors which keep the lesson from becoming tedious or stale. Another impressive technique is the fine use of many types of feedback... the hints you give are instructive and provocative -- really excellent.

Reading over this, it sounds like an awfully lot of backslapping, but you really have reason to feel proud of your work on these lessons. The following comments are mainly about those insidious details...don't be alarmed by the number of them...remember they cover a number (3?) of lessons rather than just one."

1. "object2" Using different characters to highlight important words or phrases (in other displays as well) is very effective.

2. "intro2a" This is an old comment, but one I still feel is important. The "Help" could go to the fiche of the nasal structures -- maybe with letters/numbers indicating each important structure and it's position. There's a fair chance that seeing the structure would be enough for the student to

be able to recall its name. If he is still stuck, you can then give the actual answer(s), but I think it's important to reinforce the visual association in the student's mind.

3. "nose" Putting the med. hist. on another page and moving the introduction down would highlight the information in both sections -- the med. hist. in particular. Since an upcoming question deals with whether or not the student has noticed the temp. on the hist. chart, and since a P.A. normally sees the chart separately, this seems more fair to the student.

4. "choice" Why is "make a diagnosis" the first choice? A couple of other choices seem mixed up -- any particular reason?

5. "histry3" One way to eliminate the problem of the student having forgotten some of the information is to put all the general, introductory-type sections before the specific case comments -- this would mean histry1-2 would go before the hist. part.

6. "questn1" The display acts differently depending on when and how you get there...the first time thru, everything at the bottom of the page was squeezed together and I made a note that the discussion should be moved up and the question (about watery discharge) moved down, then when I came back and went thru by condensing the lesson, the display was exactly as I was going to suggest it should be. Some restarts must be out of whack, but the way it looks via the lesson is the best.

7. "questn2" Would the word "normal" be an acceptable response?

8. "rp9a1" "rp10a1" Both talk about negative information, but don't say specifically whether it's contributory or not.

Sample
Review IV

9. "nasalexam" Move over a couple of spaces...the first line spills over into the second line. I like the help very much -- much better than when you simply gave the correct answer.

10. "nasal2" It would be nice if you'd keep the answers the student has already given when returning from the help slide.

11. "nasal3a" Would be nice to advertise some help rather than risk having the student sit at the arrow not knowing an answer, not being able to get help, and not typing in even a wrong answer (and getting help that way).

12. "nasal9" Will the text overwrite the display? Seems to indicate that it will...good idea.

13. "ear2" Maybe you could state (in parentheses) that you want a direction, even before the student responds...a bit confusing.

14. "ear8" Needs some more helpful feedback. Says to use terms like anterior, posterior, etc. You often find yourself cycling thru the possibilities and getting the same (not too helpful) feedback...might be nice to give correct answer on ntries.

Sascha

Sample
Review V

I know I've said this before, but this is a very clever lesson. You really have a good grasp of programming as well as writing lessons. A lot of bright ideas made this lesson interesting and interactive. To be more specific -- good use of animation and underlining, spelling judging and correction of misspelling. I'll try to be helpful to make this lesson even better; I have been pretty critical. In general, I feel the questioning technique can be improved -- to ask questions at the right difficulty level and measure the true understanding of knowledge -- teaching sheer rote learning is too expensive a price to afford. I have made specific comments on each unit but tried to avoid meaningless repetitions. You may find some of them rather critical. Since you have familiarity with the subject matter I also need your comments on the following review. I hope they are helpful and useful.

Susy

1. "intro" Artistic work. You really have a flair for creative animation.
2. "stuname" Allowing student to choose a name really aids the personality of this lesson.
3. "comment1" It is beneficial to have individual units commented by other co-authors or reviewers. I think it provides a good channel for improving the lesson quality. However, students may find it more handy to make overall comments at the end of the lesson when it is presented to them as a finished product.
4. "alobj" A clearly stated index page.
5. "alobj1" Wondering if one objective is adequate for mastering materials

in this section. I would suggest leaving out the headline of ALLERGY to avoid redundancy (it is the headline of the previous page); instead, give the section name A. VOCABULARY a more prominent role to attract attention to it.*

6. "tcalvoc" Underlinings are very effective.

7. "tcalvocl" Unless your idea is to have students memorize the terms and their spellings, using the fill-in-the-blank type of questions, especially when supplied with the right number of letter space, may cause a rote learning which does not necessarily require true understanding of the given material. Hint (anti) given after the first arrow also shares the same characteristic. Like the circled "but" very much.**

8. "indiv" The explanation on individualized effect of allergy is very clear. Would you think to accompany it with some real cases could be more illustrative?***

9. "indivl" The use of arrows and boxes is very effective. Somehow I was a little confused when I first looked at the animated message. Some thoughts about it...(1) "indiv2", "ralvocl2" and this unit are closely related, but the way of presenting this basic fact (i.e., atopic people are sensitive to allergen) makes the acquisition of knowledge rather too difficult. I would think rewording the text in these three units might clarify the relations among antibodies, antigens, and allergens; (2) do you feel that a particular class of antigen/allergen should be stressed somewhat to make the transition of pages more smoothly; (3) wondering whether too much emphasis has been put on the last sentence (size 4 writing) compared to the rest

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*See Figures 1a and 1b.

**See Figures 2a, 2b, and 2c.

***See Figures 3a and 3b.

ALLERGY

a. Vocabulary and Mechanism

When you complete this section -

You will be able to use precise terminology to describe the mechanics of allergy.

Figure 1a - Before

VOCABULARY AND MECHANISM

When you complete this section you will be able to -

1. Differentiate between terms used to describe the allergy mechanism.
2. Differentiate between stages of this mechanism.
3. Name the tissues affected in allergy and their physiological response.

Figure 1b - After

Antigens stimulate the body to produce antibodies.

>

Antigens are recognized by the body as _____sub-
stances

> Foreign ok

You got it!

Note: When the correct response is given the word appears in the blank space.

Figure 2a - Before

A child is protected from many diseases by being immunized at an early age. The DPT injection contains killed bacteria which stimulate the body to build up its immune defenses against the organisms which cause Diphtheria, Pertussis, and Tetanus.

In this application of the immune system, name

a specific antibody formed.

> DPT antibodies

This is how the body is stimulated to build defenses.

Note: When the student presses -NEXT- he sees Figure 2c.

Figure 2b - After

A child is protected from many diseases by being immunized at an early age. The DPT injection contains killed bacteria which stimulate the body to build up its immune defenses against the organisms which cause Diphtheria, Pertussis, and Tetanus.

BUT

All antigens do not affect all people, in the same way.

Figure 2c - After

FOR EXAMPLE

A group of people exposed to the same antigen will show a variety of individualized responses.

1. Some people will produce no antibodies.

2. Others will produce antibodies but show no symptoms.

3. Some people will produce antibodies and show symptoms.

Figure 3a - Before

FOR EXAMPLE

Picture this party. I hope you're having a good time. One of the guests is having trouble with his allergic asthma and finding it hard to breathe. You'll believe me if I tell you he's being poisoned by the room air.

Mr. Asthma is the only one to respond to this poison which is really microscopic pieces of cat fur from the feline under his chair.

Name the antigen which is stimulating Mr. A's body to produce antibodies.

> cat fur
Splendid dear Watson.

Figure 3b - After

of displayed material. The percentage of atopic population might deserve less significance (please forgive me if I am wrong).

10. "indiv2" Make the flower (symbol of allergen) more active. Perhaps it will impress the people better. That is to flash or place the flower right after the word of allergen (in the first line) in writing instead of the present form. Another thought -- since this symbol stands for allergen and antigen at different times did you find any possible confusion or ambiguity that might arise regarding the use of this symbol describing allergen/antigen business in later units?

11. "ralvoc12" Have some suggestions about the questioning technique... the fill-in-the-blank type items may only measure the acquisition of material at recall level, meanwhile, the number of letter spaces provided for answers is indeed a hint too obvious to miss, BUT, the answer space for the first arrow may cause the hesitation of filling atopic in while the number of letters indicate that it might not be acceptable. If the spelling of terms can be tested elsewhere, this unit is more appropriate for testing the true UNDERSTANDING of those terms. My suggestions are: have some real examples about different sorts of allergic results and ask the students to identify the X, Y, and Z in this mechanism (X, Y, and Z stand for antigen, allergen, and antibodies or the like).*

12. "tcalvoc3" Introducing atopy right after it was mentioned (in unit "indiv1") may be better.

13. "ralvoc3" It is a copy frame in the sense that the word "inherited" is a clue and an answer as well. Change the test item or the form of it seems necessary. The second item poses another question -- whether or not "exactly" is equivalent to 100% WRONG -- if not so, leaving out the ok/no judging and having feedback part reminding

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*See Figures 4a and 4b.

Type in your answer for the space marked by ↓.

Ten percent of the general population are atopic.

These individuals produce antibodies when challenged by

↓_____. Most people produce antibodies only if they

are exposed to other _____.

>>

Figure 4a - Before

ILLUSTRATIONS

a. The party with Mr. Aschma.

B. Infant immuniztion against DPT.

Type a or b or ab for the illustrations shown above

which show atopy

>> ab

No - Atopy is not involved
in immunization against DPT

Figure 4b - After

Sample
Review V

students that ATOPY is not exactly a disease, it is an inherited characteristic. This may make it more desirable.

14. "tcalvoc4" Fine work on animation. Good idea of capitalizing and underlining SPECIFICITY.

15. "tcalvoc5" Do you want the student to remember the term Immunoglobulin by heart or is it a satisfactory answer?

16. "ralvoc45" The use of extreme term (only) in T/F item should be avoided or the answer would be too obvious. As to the second question instead of using the blank I would suggest the short reply type question with a question mark. Is it also considered as a legal answer for the third arrow? Again, do you want students to retype or simply copy down the long word (Immunoglobulin) to enhance their memory of this word?

17. "tcalvoc" I feel the changes have been made about the process of sensitization are very helpful. The rephrasing of Mast Cell and Basophils is good, too. If antibody circulation can be animated, it will be more interesting.

Chapter VI - A Practice Review

(Developed by Merl Goldstein)

Okay, reader, you have a decision to make. This is a practice exercise for reviewing; it has an "answer key" at the end. You can (1) decide reviewing is not interesting to you and leaf perfunctorily through the practice review or (2) decide to take the practice review seriously to see how well you do. If you choose the latter, you may want to reread chapter II before beginning to review. On the next page you will also find a short summary of chapter II. If you choose (1) that's all right, too, but you're only fooling yourself if you think that you can look over the answer key and later do the practice review with valid results.

The list of potential problems (answer key) is not a review. It does not point out the things done well nor does it offer solutions.

111

Lesson Review Categories

I. Planning Stages of a Lesson

A. The purpose of the lesson

B. What content should be selected

C. Assumptions about the student's general ability and specific background

D. The relationship between a lesson and the course of which it is a part

II. The Design of the Lesson

A. Choice of the particular teaching strategies

B. Selection of media

C. The extent of individualization and differential routing

D. Organization of the content

III. Implementation/Development of the Decisions Previously Made

A. Employing the chosen teaching strategies and media effectively

B. Effective handling of individual differences in corrective feedback and remediation

C. Appropriateness of the lesson's tone and style

D. Lesson test, if any

E. Lesson flow

F. Quality and quantity of student interaction

G. Appropriateness and quality of the questions

H. The clarity of the explanations, the appropriateness of the reading level, the illustrations, and the examples

IV. Polishing/Finishing of the Lesson

A. Language

B. Consistency in the use of terms, instructions, keys, etc.

C. Technical quality of the lesson as a graphic production

D. Aesthetic appeal of the lesson

20 -

BINARY NUMBERS

Two

INTRODUCTION

Information inside the computer is represented in a kind of symbolic code. This code can be considered, in a sense, the "language" of the computer. The "alphabet" of the computer system really has only two "letters"; these can be represented in many ways, but are usually considered to consist of one letter used to show that something is ON and a second to show that something is OFF. The ON/OFF distinction is very often represented by the two digits 1 and 0.

In order to become fluent in the language of computers, it is important to know something about the binary number system and the octal number system. And in order to do that, it is necessary to have some understanding of what a number system really is.

The purpose of this booklet, then, is:

1. To describe what a number system is in terms of the decimal number system that we are all familiar with.

2. To explain the binary and octal number systems.

3. To show how these number systems can be used to represent information within a computer system.

INSTRUCTIONS FOR WORKING THROUGH THIS BOOKLET

The instructional method used in this booklet is called programmed instruction. In order to learn as efficiently as possible, work through the material in the following way:

1. Read the text on the page you are looking at.
2. Respond in the way called for.
3. Turn to the page indicated and proceed according to the instructions presented.

When you have finished the instructional sequence, work through the self test provided. In this way, you can determine how well you have mastered the contents of this lesson. Review any areas that you find troublesome.

TO BEGIN THE LESSON, TURN TO PAGE FOUR. GOOD LUCK!

As we mentioned before, the equivalent of "writing" in a computer system is the use of two "letters," different permutations of which can be used as codes that are capable of representing all information processed through the system.

The information thus represented can, of course, be either quantitative or symbolic. This means that the representational system must be sufficiently flexible to accommodate numerical knowledge and natural language.

The coding system used in most digital computers, as opposed to analog computers, is based on the binary and octal number systems.

These two number systems are uniquely qualified to serve as vehicles for this task. We will discuss the reasons for this later on in the lesson.

GO ON TO PAGE FIVE.

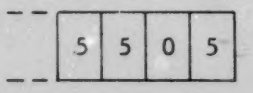
Before anything else, let's examine our own familiar number system in order to see how it works.

The first thing to notice is that our decimal number system consists of ten distinct digits:

1 2 3 4 5
6 7 8 9 0

These ten digits can be used to symbolize just about any quantity we refer to by a very ingenius method: depending upon where a digit "sits" in relation to other digits, it can take on different values!

To begin with, numbers are considered to fall into different columns -- and each column has a special meaning. For example, look at the illustration below:



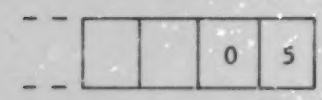
Notice that a digit takes on different meaning depending on which column it belongs to. And all columns to the right of the one on the extreme left must have a digit filled in -- even if it is only a zero to "hold the place."

The meaning of each column can be described as follows.

GO ON TO PAGE SIX.

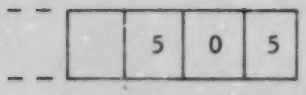
Ordinarily, we would read the number 5505 as five thousand five hundred and five. Now let's examine that phrase more closely to see what it really means.

The digit five in this column is really a shorthand way of saying that we are dealing with five groups of things, each with a single item in it.



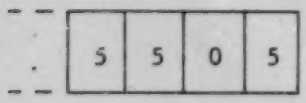
This is a shorthand way of talking about:

5 groups of a single item each
plus
0 groups of ten items each



In the same way, this group of numbers means:

5 groups of a single item each
\+ 0 groups of ten items each
\+ 5 groups of a hundred items each



And this group of numbers means:

5 groups of a single item each
\+ 0 groups of ten items each
\+ 5 groups of a hundred items each
\+ 5 groups of a thousand items each

In other words, the column in which a digit sits determines its value almost as much as the digit itself does. How does this work? That's what we will explore next.

GO TO PAGE SEVEN.

How are values assigned to each column? Well, the answer is related to the reason that elementary school children are often taught to talk about the hundreds, tens, and units columns.

Each of these columns takes its name from a value of the number 10 raised to some power. And the value of the columns increases as we go from right to left because the power to which we are raising the number 10 gets larger as we go from right to left.

THOUSANDS	HUNDREDS	TENS	UNITS ←(column)
10^3	10^2	10^1	10^0 ←(takes its name from)

The thousands column takes its name from the value of 10^3, which equals 1,000.

The hundreds column takes its name from the value of 10^2, which equals 100.

The tens column takes its name from the value of 10^1, which equals 10.

And the units, or ones, column takes its name from the value of 10^0, which equals 1.

(NOTE: any number raised to the 0 power is equal to 1).

GO ON TO PAGE EIGHT.

As you have seen, the first column on the right, the ones column, takes its value from the number 10 raised to the 0 power. The next column that follows takes its value from the number 10 raised to an exponent one number higher than the exponent in the column that came before.

OK, now we have a bunch of columns that have specific values. But we still have to see how these values relate to the digits mentioned earlier.

One way to describe what actually happens is to say that the digit that sits in a given column is multiplied by the nominal value of that column. A number, then, is in a sense, the sum of the products of each of these multiplications.

For example, the number 5505 can be thought of as meaning the following:

10^3	10^2	10^1	10^0
5	5	0	5

$5000 + 500 + 00 + 5 = 5505$

The steps in the process may be described as follows:

a. The first digit on the right is a 5.
The value of the column it is in is 10^0.

$$5 \times 10^0 = 5$$

b. The second digit is a 0.
The column it is in is 10^1.

$$0 \times 10^1 = 0$$

c. The third digit is a 5.
The column it is in is 10^2.

$$5 \times 10^2 = 500$$

d. The fourth digit is a 5.
The column it is in is 10^3.

$$5 \times 10^3 = 5000$$

e. $5000 + 5000 + 0 + 5 = 5505$

GO ON TO PAGE NINE.

In the same way, we can think of the number 396 in this way:

10^2	10^1	10^0
3	9	6

$300 + 90 + 6 = 396$

The important thing to remember now, is that no matter what number system we are dealing with, the columns are always set up the same way.

The base of the number system in question is always raised to a different power in the different columns. And the exponent used in the column to the right is always 0. Each column that follows raises the base of that number system to a power that is one higher than that of the column that came before. For example, if we were interested in a number system based on 4, we might say that the first few columns are $4^0 = 1$, $4^1 = 4$, $4^2 = 16$, etc. Notice that in each case, we have translated the value of the column into a decimal number. Then we multiply the value of that column by the digit sitting in it and add these to get the decimal equivalent of the number.

GO ON TO PAGE TEN.

Notice that the decimal number system needs only 9 digits plus the zero because the number value that follows nine can be represented by putting the digit "1" in the second column from the right, which has the value 10^1 = ten.

Therefore, in a number system based on twelve, instead of ten, we would require eleven digits in addition to zero. Since we have only nine digits in addition to zero, it would be necessary to invent two more. For example, we might arbitrarily say the symbol "#" follows 9 and the symbol "/" follows #.

The base twelve, then would be said to use these digits:

1 2 3 4 5 6

7 8 9 # / 0

On the other hand, in a number system based on eight, we really need only seven digits in addition to zero. That means we can do without two of the digits used in the decimal number system.

Thus, the only digits necessary in a base eight system:

1 2 3 4

5 6 7 0

Now you try. How many digits do you think would be necessary in a number system based on FOUR?

WRITE YOUR ANSWER DOWN. THEN GO ON TO PAGE ELEVEN TO COMPARE YOUR ANSWER TO OURS.

In a number system based on FOUR, we really need only 3 digits in addition to zero.

Therefore, the digits in a number system based on four would proceed as follows:

1 2

3 0

GO ON TO PAGE TWELVE.

Now that we have talked a bit about how a number system works, we are ready to turn our attention to the BINARY number system.

The binary number system is based on the number TWO. Since that is the case, how many digits do you think are needed in the binary number system?

WRITE YOUR ANSWER DOWN. THEN GO ON TO PAGE THIRTEEN TO COMPARE YOUR ANSWER TO OURS.

The binary number system needs only one digit in addition to zero -- or a total of two digits.

These two digits are: 1 0

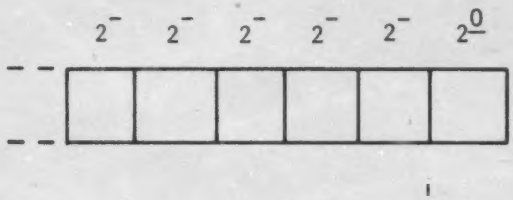
GO ON TO PAGE FOURTEEN.

We have said that the binary number system requires only two digits, 1 and 0. At the same time, values are represented in the decimal number system -- that is, by looking at the relationships between the digits and the columns they sit in.

And, since we are talking about columns again, this might be a good time to determine the values of the different columns in the binary number system.

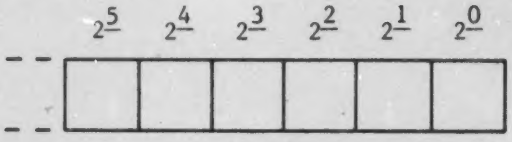
To do that, we have set up six columns in the space below. Your job is to add the exponent to each column in order to show its value.

Notice that the first one has been done for you.



WRITE YOUR ANSWERS DOWN. THEN GO ON TO PAGE FIFTEEN TO COMPARE YOUR ANSWERS TO OURS.

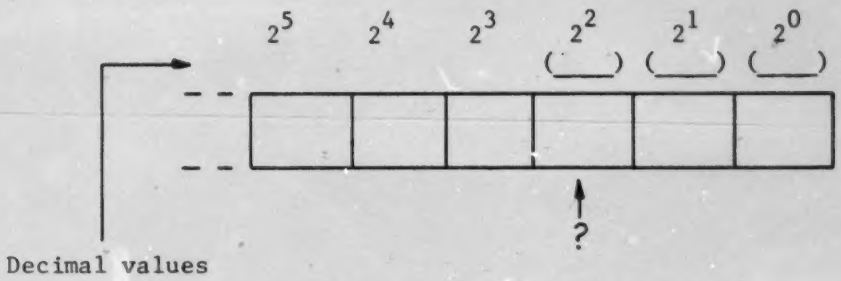
The columns should be headed as follows:



GO ON TO PAGE SIXTEEN.

Now that we have labeled the first few columns in the binary number system, we are ready to look at their value as translated into the decimal number system that we are most used to.

To determine the respective values of each column, look at the material below.



As you can see, the decimal values for the first two columns have been filled in for you.

The decimal values were computed as follows:

$2^0 = 1$

$2^1 = 2$

Now it's your turn. What would the value of the third column be?

a. 4

b. 0

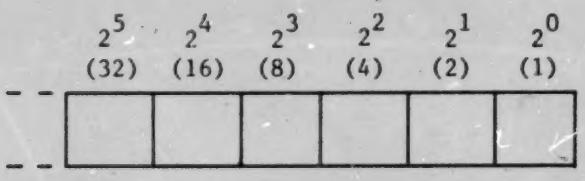
c. 400

CHECK THE ANSWER YOU THINK IS CORRECT. THEN TURN TO PAGE SEVENTEEN.

The correct answer is a. The value of this third column is 4.

GO ON TO PAGE EIGHTEEN.

Here is the complete set of values.



Just as in the decimal number system, we can represent different quantities in the binary number system by multiplying the value of that column by the digit that "sits" in that column. The resulting quantity is expressed as a decimal figure.

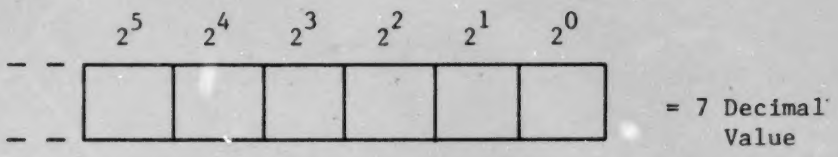
Since the binary number system uses only two different digits -- 0 and 1 -- we can think of these digits as an indication of whether or not we should "count" the column in question.

If the column is to be counted, we use the digit 1.

If the column is not to be counted, we use the digit 0.

TURN TO PAGE NINETEEN.

Now see if you can represent the quantity 7 in binary. Fill in each box with either a 1 or a 0.



WRITE YOUR ANSWER DOWN. THEN GO ON TO PAGE TWENTY AND COMPARE YOUR ANSWER TO OURS.

Look at the alternatives below. Follow the directions for the one that best agrees with your answer on page nineteen.

1. Your answer contained one or more 0's in the first three columns on the right, no matter what was on the left.

   GO TO PAGE TWENTY-ONE.

2. Your answer contained one or more 1's in the three columns on the left, no matter what was on the right.

   GO TO PAGE TWENTY-THREE.

3. Your answer contained all 1's in the three columns to the right and all 0's in the three columns on the left.

   GO TO PAGE TWENTY-TWO.

4. Your answer contained all 0's on the right and all 1's in the three columns to the left.

   GO TO PAGE TWENTY-FOUR.

5. None of the above.

   GO TO PAGE TWENTY-FIVE.

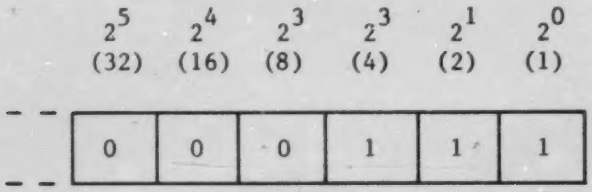
FOLLOW THE APPROPRIATE DIRECTIONS ABOVE.

If your answer contained a 0 in any of the three columns to the right, it cannot be correct.

GO BACK TO PAGE NINETEEN AND TRY AGAIN.

That's correct. Very good!

You realized that the trick is to "count" all those columns necessary to add up to the decimal number seven, as illustrated below.



0 + 0 + 0 + 4 + 2 + 1 = 7 Decimal Value

In essence, the calculations were as follows:

$2^0 \times 1 = 1$

$2^1 \times 1 = 2$

$2^2 \times 1 = 4$

$1 + 2 + 4 = 7$

Since the decimal values of all three columns to the left are equal to MORE than seven, they could not be counted. Therefore, they get zeros. Of course, in a real situation, there is no need to put zeros in any column to the left of the one furthest to the left that counts. Those columns are simply left out.

So, the decimal number 7 is represented in binary as 111.

GO ON TO PAGE TWENTY-SIX

If your answer contained a 1 in any of the three columns to the left, it cannot be correct.

GO BACK TO PAGE NINETEEN AND TRY AGAIN.

You seem to have misunderstood the meaning of the digits 0 and 1. This answer is incorrect.

GO BACK TO PAGE EIGHTEEN AND REREAD THE LAST PARAGRAPH. THEN TRY AGAIN.

Twenty-five

You obviously have not been paying attention.

REREAD PAGE EIGHTEEN AND THEN TRY AGAIN.

To summarize, the binary number system used only two digits -- 0 and 1.

The need for only two digits makes the binary number system an ideal vehicle for representing information within the computer. Why is this so?

Well, many of the elements of the computer system contain components which can be described as being in either one of two states. For example, the computer's electrical circuitry can be either ON of OFF. And the magnetic tape used in a computer system can be polarized in one of two ways -- POSITIVE or NEGATIVE.

Magnetic tape is used to store information in the computer system that is not being immediately used. The information thus stored is in a sense "filed away" until it is needed for some future operation.

Some computer systems store information away on magnetic discs instead of magnetic tapes. The advantage of a disc is that it is possible to get to a piece of information in the middle of the disc directly. In contrast, if one wants to get a piece of information from the middle of a tape, it is necessary to unwind the tape until the desired spot is reached.

The two kinds of ways of getting to information -- directly, or only by running through the entire "file" -- are called respectively:

RANDOM ACCESS

and

SERIAL ACCESS

GO ON TO PAGE TWENTY-SEVEN.

In the space below, indicate which of the two kinds of storage materials illustrates RANDOM ACCESS and which illustrates SERIAL ACCESS.

magnetic discs are a kind of _____ access.

magnetic tapes are a kind of _____ access.

WRITE DOWN YOUR ANSWER. THEN GO ON TO PAGE TWENTY-EIGHT AND COMPARE YOUR ANSWER WITH OURS.

The correct answers are:

discs -- random access

tapes -- serial access

GO ON TO PAGE TWENTY-NINE.

You have now completed the teaching sequences of this lesson.

Now you are ready to take the self-test that follows.

After answering all the questions and checking your answers against the answer key, you will have a better idea of what parts of the lesson you have mastered.

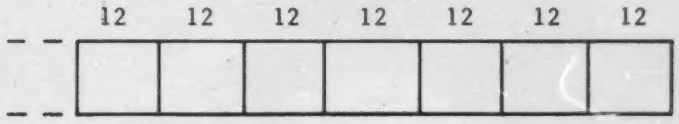
Once you find the questions you got wrong, go back and reread those pages that deal with the material in question.

GO ON TO PAGE THIRTY AND TAKE THE SELF-TEST.

SELF-TEST

Answer each of the following questions. Then check your answers with the answer key.

1. Add the appropriate exponent to each column below to express the value of that column in a number system based on the number 12.



2. What is the decimal value of the following binary numbers?

BINARY		DECIMAL
001100	=	
100000	=	
010101	=	

3. What is the binary value of the decimal numbers below?

DECIMAL		BINARY
27	=	
11	=	
2	=	

4. Describe in your own words the special relationship between the octal and binary number systems.

5. What is the decimal value of the following octal numbers?

OCTAL		BINARY
35	=	
20	=	
7	=	

6. Why is the binary number system a good way to represent information within the computer?

7. What decimal number does 8^0 equal?

ANSWER KEY

1. 12^6 12^5 12^4 12^3 12^2 12^1 12^0

2. DECIMAL

   12

   32

   21

3. BINARY

   011011

   001011

   000001

4. Three binary digits translate easily into an octal digit.

5. DECIMAL

   29

   16

   7

6. ON/OFF is easily represented with two digits.

7. $8^0 = 1$

LIST OF POTENTIAL PROBLEMS

GENERAL COMMENTS

1.	Title, objectives as stated, and test are inconsistent with text: octal is not treated.	LEVEL 1
2.	The text contains a digression irrelevant to objectives as stated and to test: discussion of tape vs. disc storage.	LEVEL 1
3.	At least one questionable assumption: that students know about exponents and powers.	LEVEL 1
4.	No attempt made to individualize/differentially route students (who are likely to have heterogeneous backgrounds in math).	LEVEL 2
5.	Type face single spaced seems to be a bit hard to read.	LEVEL 4
6.	There is at least one long stretch with no interaction - that means no way of telling if the student has mastered the material, or is even paying attention.	LEVEL 3
7.	The title page is rather unattractive.	LEVEL 4
8.	The layout wastes paper.	LEVEL 4
9.	Not enough practice in the skills necessary to respond correctly to test items. There seems to be a need for some drill and practice segments.	LEVEL 2/3
10.	There is no differential remediation when the student answers incorrectly (except in one instance, when it is very unsatisfactory -- see specific comments).	LEVEL 3

SPECIFIC COMMENTS

Page	Comment	Level
Four	Reading level seems much too high	LEVEL 3
Five, Six	Too much exposition without interaction	(#6 - gen. com.)
Seven	Assumption that S knows exponents	(#3 - gen. com.)
Eight, Nine	Ditto lack of interaction	(#6 - gen. com.)

Page	Comment	Level
Nine	New concept introduced at the tail end of the frame	LEVEL 3
Nine	Example buried in mound of text in last paragraph	LEVEL 3
Nine	Explanation unclear in last paragraph	LEVEL 3
Ten, Twelve	No attempt to individualize on basis of the student's response	(#4 - gen. com.)
Ten, Twelve	The "rule" is never made explicit	LEVEL 3
Fourteen	Instructions telling the student what to do are unclear	LEVEL 3
Sixteen	Instructions telling the student what to do are unclear	LEVEL 3
Sixteen	Labeling is awkward	LEVEL 3
Sixteen	Poor question: the distractors give it away since they are so obviously wrong	LEVEL 3
Seventeen	No remediation if the student doesn't understand	(#10 - gen. com.)
Eighteen	Abrupt transition to different material between paragraphs 1 and 2 and between 2 and 3	LEVEL 3
Eighteen	No examples provided	LEVEL 3
Eighteen	The label "decimal value" is missing	LEVEL 3
Nineteen	Huge jump between pages eighteen and nineteen as far as skills involved	LEVEL 3
Twenty	The choices are nonexclusive (1 and 2 overlap 4).	LEVEL 3
Twenty	No chance for the student to say "I don't know."	LEVEL 3
Twenty	Choices are awkwardly worded	LEVEL 3
Twenty-one	No explanation as to why that is wrong. No help	(#10 - gen. com.)

Page	Comment	Level
Twenty-one	Simple recycling the student back to the same question with no help is frustrating.	(#10 - gen. com.)
Twenty-two	Putting the explanation of how to get the correct answer as feedback to the correct answer is rather pointless. The poor student really needs it when he is wrong. As a review, this is not a bad idea, but as the only teaching sequence on the point, it is poorly placed.	LEVEL 3
Twenty-two	The explanation of the correct answer is unclear.	LEVEL 3
Twenty-two	Including new information in the feedback is not usually a good idea since students are not expecting it there and tend not to pay as much attention.	LEVEL 3
Twenty-three	Ditto Twenty-one	(#10 - gen. com.)
Twenty-four	Ditto Twenty-one	(#10 - gen. com.)
Twenty-five	Ditto Twenty-one	(#10 - gen. com.)
Twenty-six	This is a digression.	(#2 - gen. com.)
Twenty-six	The same frame is being used for two distinct purposes (review of preceding concept and introduction of a new one) with no signal to the student when he comes to the bridge between the two.	LEVEL 3

Test	Comment	Level
Q1	The words "the value" are repeated.	LEVEL 4
Q2	Student has no practice using this skill in the lesson.	(#9 - gen. com.)
Q3	Student has had no practice using this skill at this level of complexity.	(#9 - gen. com.)
Q4	This material is not covered in the lesson.	(#2 - gen. com.)
Q5	Ditto Q2	(#9 - gen com.)

Test	Comment	Level
06	Student was never requested to formulate a response to this before. It was merely briefly presented	(#9 - gen. com.)
07	Covers point just mentioned in passing. Students are likely not to recall it.	LEVEL 3

21 - DISCUSSION

The preceding segment of "rigged" programmed instruction was used by Ms. Merle Goldstein in 1974 to test the hypothesis that reviewing skills could be taught.* Thirty-two students enrolled in Educational Psychology 211 participated in the experiment. Because Educational Psychology by Anderson and Faust (1973) was an assigned text for this class, the experimenter assumed the students had some familiarity with the concepts to be examined by a review. Seventeen subjects (experimental group) read some introductory materials giving the background and rationale for lesson reviews and then studied a set of review guidelines differing only slightly from those found in chapter II. The other subjects (control group) read a paper discussing the PLATO and TICCIT systems. At the end of the session for both groups, the materials were briefly discussed and handed in. At a second session all students were given the practice review segment to critique. Only the students in the experimental group were given the guidelines to use during the session. The criticisms made by the students were placed on the programmed instruction booklet and/or on blank paper. All materials were gathered and scored "blind" independently by two scorers. All

*Some Guidelines for the Review of Instructural Materials by Merle Goldstein, 1974, University of Illinois (unpublished Master's thesis).

comments except frame responses were classified as:

Category A: Structural comments. Level 1, 2, and 3 considerations.

Category B: Editorial comments. Level 4 considerations.

Category C: Miscellaneous comments

Though scoring was necessarily subjective, interscorer reliabilities for categories A, B, and C were .90, .94, and .94. Each student's score for each category was found by averaging the total number of comments the scorers found. Goldstein produced the following table of results:

Table I

Summary Data by Category and by Group

	Structural		Editorial		Miscellaneous	
Condition	M	SD	M	SD	M	SD
Experimental (n=17)	7.53	4.42	1.74	1.84	3.38	3.52
Control (n=15)	3.23	3.25	0.13	0.30	4.03	4.96

Analysis of variance indicates the superiority of the students in the experimental group in categories A and B was significant at the .005 level. There was no significant difference in the number of category C (miscellaneous) comments recorded. Goldstein observed that though students in the control group were extremely vocal in their disapproval of the lesson, they were apparently unable to focus on specific problems or to channel their feeling into "constructive criticism" of the lesson.